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THE WAR ON PRIVATE CITIZENS

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Paper Pulp Problem

THE problem confronting papermakers of discovering sources of new papermaking material becomes every day more pressing. The prime material in use to-day is wood. Attention was directed to the possibilities of wood as a source of papermaking material by Schäfer, of Ratisbon, in 1765, just 150 years ago; but it was not until the middle of the nineteenth century that the commercial use of the pulp of wood was seriously considered. As Schwalbe has noted in one of his illuminating contributions to the literature of cellulose, Schäfer's experiments brought no results except the contempt and jeers of his contempararies.

The problem in Schäfer's time was to discover a substitute for rags, old linen and cotton waste, which were getting scarce even then, and it is mentioned here to show the similarity in questions which are of periodical recurrence, as well as to give point to a modern issue; for as late as the year 1854 the London *Times* was offering a reward of 1,000 pounds "to any person who shall first succeed in inventing or discovering the means of using a cheap substitute for the cotton and linen materials now used by papermakers, subject to the following conditions:

"1. The material must be practically unlimited in quantity, and be capable of being converted into pulp of a quality equal to that which is at present used in manufacturing the best description of newspaper, and at a cost, *cæteris paribus*, not less than ten per cent lower.

"2. It must be tested, approved, and adopted by three eminent manufacturers of paper (two of them to be named by the advertiser), whose certificate shall entitle the inventor to the payment of the reward.

"3. This offer will be in force for a period of twelve months from the 26th of May, 1854."

Papermakers are dependent on the wood of certain pine, spruce and fir trees for the fibers which compose nearly every variety of paper except what are known in the trade as "fine papers"; that is, bonds, ledgers and writing papers; and it is only the finer and more expensive grades of writing paper that are free from chemically prepared pulp of wood. The rate of consumption of wood pulp has, indeed, increased so tremendously of late years as to threaten the raw material with extinction, a fate which has already overcome the spruce pulp wood forests of the United States; the great bulk of our wood and mechanical pulp being now obtained from the vast tracts of forest lands still accessible in Canada and in Scandinavia.

The SCIENTIFIC AMERICAN, keenly cognizant of the pressing importance of the problem confronting the American paper industry, never neglects an opportunity of directing attention to possible new sources of papermaking material, processes for the re-use of used material, or inventions for the utilization of waste and by-products. In this way note was made in a recent issue of the possibilities of producing pulp from cotton stalks, based on the report of an interested student of the subject. The article created considerable interest and led to numerous inquiries from individuals and firms interested in papermaking.

The history of modern invention in papermaking processes, since the classical experiments of Schäfer, teaches caution in the attitude one must observe toward the claims put forward in behalf of any new invention. While time has amply justified the ideas of Schäfer with regard to the manufacture of paper from a large list of vegetable materials, including wasp nests, peat, straw and the twigs of hops, the utilization of such materials on a commercial scale must wait until the scarcity of forest trees becomes more pressing. The fallacy of proposing various weeds, grasses, waste cotton and corn stalks and many other vegetable matters to furnish fiber has been exposed over and over again by practical men who are aware of the enormous masses of material required and the expense of reducing and bleaching them, to say nothing of the weakness and inadequacy of the resulting fiber as compared with that obtained from wood. The conclusion reached in an article published in the issue of the SCIENTIFIC AMERICAN for January 3, 1914, is still pertinent: "Until the price of wood pulp rises to a higher figure than at present, these processes must wait for commercial development, serving meanwhile little more than reserve processes."

A Notable Map of Europe

IN the July number of the *Geographical Journal* Mr. Arthur Hinks, who recently succeeded Dr. Scott Keltie as secretary of the Royal Geographical Society, describes a remarkable cartographic undertaking upon which that famous society is now engaged.

It will be remembered that the preparation of an international map of the globe, on a uniform plan and on a scale of 1:1,000,000, after having been talked of for years as an urgent desideratum, was actually undertaken by the principal nations of the world, following an international conference on the subject held in London in November, 1909. This work had, however, made but little progress up to the year 1913, when a second conference was held in Paris, to settle numerous details that had been left undecided at the first one. The proceedings of the Paris conference have not yet been published.

When the great European war broke out, the need of a uniform and detailed map embracing the various theaters of war and their surroundings was urgently felt by the British military authorities, and only half a dozen European sheets of the International Map had appeared. As each sheet extends over six degrees in longitude and four in latitude, this means that but a small fragment of Europe had been covered.

Almost as soon as the war began the talents and resources of the Royal Geographical Society were dedicated to the task of producing a skeleton map of western Europe, adequate for various military purposes, and this has already proved very useful to the British army, especially to the Royal Flying Corps. This enterprise, however, soon developed into the much more ambitious one of mapping the whole of Europe and the Near East on a scale of 1:1,000,000. In other words, the society undertook to produce, single-handed and with great rapidity, an approximate equivalent of what the International Map of these regions would have been if it had been completed. The work has made very substantial progress. The society compiles the material and prepares the first draughts of the various sheets, which are then redrawn and published by the Ordnance Survey and the War Office. It was expected that from fifteen to twenty sheets would have been published by the first of August. Several have already appeared.

Even in time of peace, with material and personal aid from the geographers of all the now belligerent countries at the disposal of the cartographers, such an undertaking would have bristled with difficulties.

As might be expected, the spelling of names has been one of the most serious problems; or, rather, it involves a host of problems. It seems a comparatively simple plan, in the case of countries using the Roman alphabet, to adopt in every case the official spelling used in the country itself, until one finds that even official spellings vary! Thus, at least three spellings of "Bucharest" (none of which agrees with this English spelling) are found in Roumanian government publications.

The greatest difficulties, however, arise from the existence of non-Roman alphabets, such as Russian, Greek, Turkish, etc. Just one example of these difficulties may be mentioned here. In Russian Poland all places have, of course, official names which the Russian authorities write in the Cyrillic character, and this character can be turned into Roman according to a uniform system of transliteration. It appears, however, that such names have been transliterated by the Russians from the Polish (which uses the Roman alphabet with various diacritical marks), according to an arbitrary and faulty system, so that retransliteration into the Roman alphabet produces, in many cases, something quite different from the original Polish name!

The Revival of Blood Letting

ONE recalls how Gil Blas, being at one time in his interesting career very hard put to it for a livelihood, had the good fortune to become assistant to the great Dr. Sangrado, and found himself, without more ado and as easily as any modern quack, a physician qualified to treat any and every human ill, for his chief's armamentarium consisted of the lancet and hot water, with the use of which Gil quickly became familiar. Hot water continues to-day a therapeutic essential. But phlebotomy has long since fallen into innocuous desuetude, mainly because the practice was absolutely without discrimination; every sufferer from no matter what illness was bled, and often to a degree which seems ghastly to the reader of medical history And not only were the sick, but also the well, regularly bled, once or more the year, so that the lancet marks on the body were more in evidence than are vaccination scars to-day. A reaction from such practice, by which the death of our first President was certainly hastened, was of course inevitable.

Venesection, or blood letting, is, in discriminated instances, a salutary measure; there are times when it is absolutely essential to life. It must, however, not be done haphazard, in the manner which brought it into disrepute—but scientifically, that is, with knowledge of the disease conditions for which it is appropriate.

Upon what principles? Treat not the disease, to let the patient die; but treat the patient and let the disease die. Judge of the propriety, the amount and the necessity of the repetition of blood letting, by the symptoms exhibited in each case, and not by the nomenclature; observe also the natural constitution of the patient, withholding the lancet in the extremes of life; nor bleed when the blood itself is weak; nor in those invalided for a long time; but bleed when the blood is poisoned by the toxins of virulent infections; when there is excessive vascular tension; when the right chambers of the heart are packed by the excessive unloading into them of thick "black blood" from the engorged systematic veins. There surely can be nothing more scientific nor up-to-date than these principles—which are, in the main, those taught by Galen.

We may not here enter into particulars such as should obtain strictly in the medical domain, save to note some very recent researches made by Drs. Abel, Rowntree and Turner in the Johns Hopkins Medical School. From a pint to 22 ounces has often been safely venesected from human beings; but to remove more than one third the body's blood supply were dangerous indeed. Not so much by reason of the abstraction of considerable blood plasma, the fluid part of the blood, which is easily enough renewed; but the danger lies in the reduction of the number of the red blood corpuscles or cells, which circulate in the blood plasma and have for their office the conveying of oxygen, the life-sustaining gas, to the body's uttermost parts. The excessive loss of these cells puts a task, likely to prove unsurmountable, on the organs which normally regenerate those corpuscles. Wherefore those Baltimore scientists have worked on the idea of repeatedly removing large quantities of blood, separating the corpuscles from this by the use of the centrifuge, replacing the plasma by Locke's solution, and reinjecting this, together with the sedimented corpuscles. This method is as yet unjustifiable in human beings. But their experiments on animals have shown the possibility of withdrawing, without apparent injury, blood plasma several times in excess of the maximum that can be safely drawn by the usual methods of blood letting, provided the corpuscles, suspended in a suitable medium (as Locke's solution) be returned to the vascular system after each vivisection.

Certain it is that centrifugated mammalian blood cells can retain their stability and their vitality when kept on ice four to five days, to functionate normally on being reinjected into the body. Thus, observes the *Journal* of the American Medical Association, a supply of human corpuscles might possibly be kept in operating rooms, for rapid injection in emergencies that would otherwise prove fatal. And in the preparation of antitoxin serums from the horse this procedure might obtain: instead of bleeding from that friend of man a few quarts every fortnight, much more might be taken in the same or even shorter intervals, if the animal did not have to regenerate his corpuscular elements.

Colors of Man and Animals

AT a recent meeting of the German Anthropological Society, Prof. Ed. Hahn lectured on human races and properties of domestic animals, dwelling especially on such relations as are found to exist between the outward appearance of human races and the races of man's animal companions. The hues mainly occurring in the case of man as well as of domestic animals are black, brown, red, yellow and white, a remarkable feature being that these external characteristics seem to be connected with the whole of bodily constitution. A distinguished anthropologist, Prof. Eugene Fischer, of Freiburg, Badenia, on evidence afforded by the eye of mammals, considers the whiteness of domestic animals and white man to be kindred phenomena, nor does he hesitate to suggest many other analogies of a similar kind between man and animals. According to the lecturer, humanity as a whole, inclusive of what are called primitive peoples, has been subjected for some time, to conditions similar to those at work in the case of our domestic animals. The classification mainly based on color may be replaced by a system of darker and lighter strains within a given race. Attention is drawn in this connection to the Simmenthal oxen, which, within memory of man, have become remarkably bright-colored, as well as to the fact that the subsequent darkening of adults points to the merging, in olden times, of brighter and darker varieties of man.

Electricity

The Removal of Tar from Gas by Electricity is the subject of a patent recently granted to an inventor of Detroit. The operation consists essentially of passing the gas through an electrical field of alternating polarity between receiving and discharging electrodes. It is claimed that the particles of tarry substances in the gas then coalesce and are deposited on the receiving electrode.

Prepared Paper for Insulation.—There has been introduced in Germany a new form of insulating material which is known as "Pertinax." It is made by rolling layers of paper on one another; the mass being then impregnated in some kind of resin while heat and pressure are applied. The different layers adhere to such an extent that the resultant "hard paper" appears uniform in structure. The new insulating material is water-proof. It is almost as free from chemical action as porcelain. It will stand temperatures of 180 or 200 deg. Centigrade without harm. "Pertinax" is most readily prepared in flat sheets or cylinders, and it lends itself admirably to machining. Tests indicate that it can be used indoors in replacing porcelain for pressures above 20,000 volts.

Arrangement of Street Lamps.—A recent investigation of the relative merits of parallel and staggered arrangement of street lamps is most interesting, since it discloses that from an ornamental viewpoint, the former is preferable, while, from a utilitarian viewpoint, the latter is preferable under certain conditions. By parallel arrangement is meant the placing of lamps so that they come opposite each other, while staggered arrangement means that the lamps on one side of a street are placed so as to come half way between those on the opposite side. In general, the staggered arrangement furnishes more uniform illumination. However, where the street width is not much greater than the distance between lamp standards, the parallel arrangement is preferable. In instances where the street width is considerably greater than the spacing of the lamps, the staggered arrangement will give the best results.

Doors Controlled by Electric Push Buttons.—A Chicago concern has evolved a motor equipment for the opening and closing of hinged doors by the depressing of push buttons. The apparatus consists of a small motor, which drives a grooved drum through a worm gear; a continuous rope which applies the motor's power to the doors; a contactor panel; push buttons, and the necessary accessories. The motor and contactor equipment is fastened to the ceiling, near the doors which it operates. A three-button control panel is placed at any convenient point. One button opens the door, another closes it, and the remaining one stops it. A limit switch shuts off the current when the doors are either completely closed or opened to their full width. It is believed that the equipment will eventually replace the men who are now employed to open and close doors in packing houses and warehouses.

Electrically-Operated Stop Watch.—There has recently been introduced an electrically-operated stop watch which lends itself to a variety of applications in the fields of industry and sport. The watch is of the conventional split-second type, but the second-hand is started by the closing of an electromagnet circuit instead of by the depressing of a button. The watch may be used in conjunction with a speed counter, in which case the circuit is closed and the second-hand started at the instant the speed indicator begins to rotate. Removing the speed indicator from a shaft or pulley opens the electromagnet circuit and stops the second-hand. Another interesting application of the new watch is in connection with foot races, in which instance several watches are mounted on a panel and each connected to a device at the end of the respective lane. The watches are all started at the crack of the starter's pistol, but stop individually the moment each runner crosses the tape.

Arc Lamps of New Design.—Speaking at a joint meeting of the New York Section of the American Electrochemical Society and the Illuminating Engineering Society, W. A. Darrah described a new type of arc lamp which he has evolved. The lamp consists essentially of an arc chamber in the center of which the arc is drawn between two tungsten electrodes measuring 3-16 inch in diameter. In order to maintain the arc squarely between the electrodes, the latter are partly surrounded by a refractory insulator. Tungsten has been selected for the electrode material for the reason that it is inert, even at a white heat, in the presence of the various vapors used in the lamp. Among the vapors that have been used in the lamp are titanium, stannic chloride, antimony tetrachloride and carbon tetrachloride. The arc chamber is exhausted before the vapors are introduced. The efficiency of the new enclosed arc lamp, together with its convenience—no electrodes to renew or trim—holds much promise for extensive research work in this field of artificial illumination.

Science

Sir Arthur Rücker, who died November 1st, was especially well known for the magnetic survey of the British Isles which he carried out in conjunction with Prof. Thorpe. This work occupied more than 14 years. Rücker was formerly principal of the University of London, retiring in 1908. He was president of the British Association in 1901.

The Superiority of American Clays for use in connection with the glass industry has been demonstrated by tests at the Pittsburgh laboratory of the Bureau of Standards. The Bureau announces that American glass manufacturers will hereafter be independent of foreign material for this purpose. The glass refractories (pots in which the glass is melted) prepared of American clays have been found to give better results than those manufactured with the addition of German plastic clays, or of German clays alone.

Monthly Weather Charts of the North Atlantic Ocean are to be published in the future by the Weather Bureau in the *Monthly Weather Review*, together with descriptive summaries of the principal weather conditions prevailing over the ocean month by month. The Bureau will thus make available the great mass of information received from its corps of marine observers, who are chiefly officers of ships, of all nationalities. The material for a given month will be published one year late, to allow ample time for the receipt of reports.

Teaching Farmers to Make Maple Sugar.—A consular report states that the quality of the maple sugar and sirup which constitute one of the chief industries of the Province of Quebec has been greatly improved by the establishment of three sugar-making schools; one in Beauce, another in the county of L'Islet, and a third in the county of Labelle. These schools are very popular with the farmers of the province, and help to explain the fact that Quebec's production of maple sugar and sirup, as shown by the last census, was $1,680,393.

Weather Reports from Alaska.—Thanks to the extension of the radiotelegraphic service in Alaska, the Weather Bureau forecasters have been enabled to enlarge their field of observation and now receive daily reports from eight stations in that territory and the adjacent islands. Important extensions have also recently been made in the network of stations that keep records of meteorological conditions but do not send telegraphic reports, so that an important body of climatic statistics is growing up, to keep pace with the growing demands for information on the part of prospective settlers.

The Sea Route to Siberia.—In continuation of notes previously published in these columns on the development of a trade route to Siberia *via* the Kara Sea and the Arctic Ocean, it may be stated that successful voyages were again carried out during the past season of navigation. Mr. Jonas Lied reached England, October 11th, with two steamers, bringing cargoes of Siberian produce from the districts of the Obi and the Yenisei. He testified to the utility of the Russian wireless stations at the entrances to Kara Sea. When going east ice was encountered west of the straits, but he received news by wireless that the straits themselves were free, and was thus enabled to proceed.

Protective Stripes Used by Savages.—Describing in the *Geographical Journal* his explorations in the Belgian Congo, Dr. Cuthbert Christy records that in traveling from Stanleyville to Avakubi he came upon a group of forest natives remarkable for the curious way in which they mark their bodies for the purpose of concealment. Narrow stripes of black or red are marked on limbs and face, and sometimes the body. This device has the effect of breaking up the outline and making the person less conspicuous in the lights and shadows of the underwood. Even in the sunlight the duikerboks of the forest will run past the motionless hunter without perceiving him, and are caught in nets. It is interesting to note that an analogous device has come into use during the present European war for concealing vessels, guns, etc.

Panama Hospitals, Past and Present.—The Museum of Natural History in New York has recently placed on exhibition instructive models showing the remarkable improvement in hospitals on the Isthmus of Panama between the days of the French canal company and the present time. A hospital of the French period is shown, in care of Sisters of Mercy. Pools of stagnant water are seen in the grounds, while the legs of beds stand in tins of water, to prevent the enterprising ants, the pest of the Isthmus, from climbing up. Both pools and tins were breeding grounds of malarial and yellow fever mosquitoes, a fact quite unsuspected in those days. Lastly, window screens are conspicuous by their absence. The other part of the exhibit is one of the French hospitals modified in accordance with modern ideas, with well-kept grounds, dry cellar, screens, good ventilation and trained nurses.

Automobile Notes

American Takes Charge of Russian Trucks.—In an endeavor to bring order out of the chaos of Russian motor truck transportation, particularly where American-made trucks are used, the Russian government last month engaged a Baltimore taxicab service expert to take charge of the entire business.

Night Accidents in London.—Since the streets of London have been "darkened" at night, on account of the Zeppelin raids, there have been many accidents to pedestrians from being run down by automobiles. In a recent court case of this kind a bus driver suggested that pedestrians, especially women, should wear light colored clothing. He also said that if people carried a newspaper, or a white handkerchief, when crossing a street at night, automobile drivers could more easily distinguish them in time to stop. The latter idea might be useful in other places besides London.

Italy Adopts Agrimotors.—Following the example set by France in the subsidizing of motor tractors and other agrimotors, the Italian government has decided to take similar steps in order to prevent the abandoning of farms for which human labor is not obtainable. The first attempts at communal motor-farming have been made in the province Cagliari, and public demonstrations of the uses to which agrimotors can be put are to be given in all the provinces under the auspices of the department of agriculture. American farm tractors and farming machinery are greatly desired in Italy at the present time.

Protecting Roads in Winter.—The Department of Agriculture calls attention to the fact that water, and not cold, is the cause of injury to roads in winter, even those of the best construction. It is obvious, therefore, that it is a matter of economy, from every point of view, that roads should be as dry as possible when winter comes on. During the fall the road should be carefully gone over, and all ruts and hollows that can hold water solidly filled in to make the camber of the road surface such that it will drain quickly and thoroughly. Standing pools at the side of the road should also be drained, as they tend to soak and soften the foundations of the road, which may result in bad "heaving" when a freeze comes.

Safety at Railway Crossings.—Although many people are beginning to think that the man who meets disaster by racing a railway train to a crossing is worthy of little sympathy, still there are enough genuine accidents to stimulate suggestions for increasing safety at these points. One apparently effective plan recently proposed is to turn the road at a right angle near the tracks and continue it parallel with the tracks for a short distance before crossing the same by another right angle turn. This would compel an automobile to slow down before crossing the tracks, and should insure the safety of the average driver. Unfortunately there are very many places where such an arrangement is impossible.

Easier Riding Promised.—One of the improvements promised for the coming year is an easier riding car—which is an acknowledgment that there was still something to be desired in this direction. Whatever improvements are effected there seems to be no reason to expect that it will be possible to discard the shock absorber, which has heretofore been found indispensable by those who are critical about their comforts; and this raises the question whether the long, flat laminated spring is the best means for absorbing road shocks, for even with the best designs there is no question but that an additional device is required to modify the rebound, and as a matter of fact the initial flexure is either too stiff, or else too sudden, although not as objectionable as the rebound. There appears to be an opportunity for a radical change in this feature of car building.

Maintenance Cost of Trucks.—Many business men hesitate to adopt power driven trucks, notwithstanding their remarkable efficiency over horse-drawn vehicles, because of the excessive repair expense developed in some cases. That this is the result of misuse by the drivers, rather than any fault of the mechanism, will be appreciated by anyone who observes for a short time the way many trucks are handled in city streets. Overloading is a common abuse; and equally destructive is the driving of a heavily loaded truck at excessive speed over defective pavements, pot holes and car tracks. No materials now known will survive such treatment, and as much judgment is required to operate a motor truck as was considered necessary to drive valuable horses. A means for overcoming such conditions would be the application of some kind of a recording speed indicator in connection with a clock. With a record of this kind, together with a report of trips made and routes taken, the owner of a truck can easily keep a check on the doings of his drivers; and these same records would also enable him to operate his trucks to the best advantage.

Protecting Galveston's Sea-Wall

Repair Methods Which Are Being Used in Repairing Recent Storm's Havoc

THE different methods used by the engineers in charge of replacing the rip-rap which was washed away from in front of Galveston's justly famous sea-wall in the storm of August 16, 1915, are presented in the accompanying views. This rip-rap consisted of rocks, mostly granite, varying in size from a few pounds to several tons.

Prior to the storm, which destroyed millions of dollars' worth of property and cost hundreds of people their lives, the rip-rap extended out on the beach a hundred feet or more, its object being to break the force of the waves before they struck the sea-wall. The force of the storm entirely destroyed the beach, which is gradually rebuilding, however, and lifted these huge rocks clear of the sea-wall, and hurled them in some instances across the boulevard, just inside the sea-wall and 100 feet wide. The small stones contained in the rip-rap practically disappeared. The destruction of the beach and rip-rap enabled the waves to wash all sand away from the front of the sea-wall, thereby exposing the sheet piling under it to the action of the teredo, a destructive worm which attacks and rapidly destroys wood. It is to prevent the action of the teredo and to assist nature in rebuilding the beach, as well as to break the force of the waves, that the rip-rap is being replaced.

The first photograph shows the means used at Galveston by the Engineer Department, United States Army, to protect the sea-wall in front of the Government reservation at Fort Crockett. The sheet piling at this part of the sea-wall was badly exposed, and the repair was an emergency one. There was about 2,600 feet of Government sea-wall to protect. The rapid action of the teredo called for quick work. The derrick shown was constructed on the spot and moved along the inside of the sea-wall by means of a cable and winch. The boom had a length sufficient to dump the rock about ten feet in front of the sea-wall. The method of handling the rock was to have a loaded wagon with a detachable body drive up to the derrick, where a chain was fastened around the wagon body, and then, by means of the boom, it was lifted across the sea-wall and dumped. This method worked very satisfactorily for an emergency arrangement. The rock used in the wagon bodies was known as "one-man rock," which means rock weighing from 10 to 25 pounds, or as much as one man can conveniently handle.

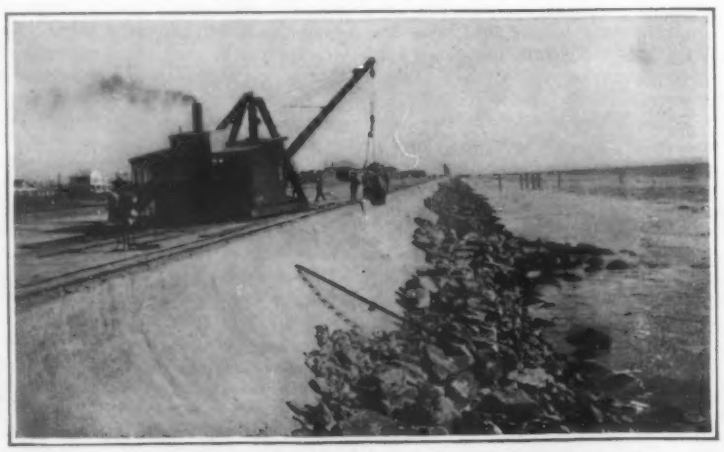
In the second view appears the next step in protecting the sea-wall. Altogether, there is about 2½ miles of sea-wall to protect. This part is being done by contractors. The small locomotive in the foreground is of the gasoline type and is rated at 60 h.p. The track has a gage of 24 inches, and is laid on top of the sea-wall, which is 5 feet across, without any ballast other than a few inches of sand in spots. The rock used at this time is a little larger than the "one man rock," and is brought to within about 400 yards of the sea-wall by rail, where it is unloaded into the small dump cars shown, and then run up on to the sea-wall and dumped over. The small engine pulls from 10 to 15 cars at a time, each car holding about 1½ tons of rock, and a round trip is made every 30 minutes. The cars have to be dumped individually, but the method of dumping them is so simple they can be dumped as fast as a man can walk from car to car. The cost of placing this rock is about $1.75 a ton. After enough rock of this size has been placed, the little train is used to dump "mud-shell" and sand to fill in the interstices between the rocks. Only two men are required to run engine and dump cars.

The third view shows the final rock used, which protects the sea-wall from the striking force of the waves—the preceding work protecting the piling from the teredo. The rock used by this derrick weighs from 1 to 10 tons, and is swung and placed just outside and on top of the previously placed rock. While a 10-ton rock seems as though it were a huge rock, it is none too large, as was demonstrated by the storm, which, among other seemingly impossible things, tore loose from their bases two 18-ton granite blocks that were erected as monuments to commemorate the building of the sea-wall, and moved them across the boulevard, a distance of 100 feet, without leaving a scratch on the cement walk or brick roadway. Examples such as this demonstrate what the waves can do when lashed by a severe storm, and cause the people of Galveston County to spare no expense to protect the sea-wall which so ably protected them last August.

In the first view where the derrick stands and for a distance of about 2,500 feet was solid fill and a wide brick boulevard. This was all destroyed in the storm. In the third view the piles seen are all that remains of a famous bath house.

Improvised derrick used by the engineers repairing the Galveston sea-wall, with the contractor's railway at the right

Train of dump cars hauled by gasoline locomotive, used in the repair work on the Galveston sea-wall



Steam derrick employed in handling the final rock, the pieces of which vary in weight from one to ten tons

Zacaton, A New Paper-Making Material

ACCORDING to Bulletin 309 of the Bureau of Plant Industry, U. S. Department of Agriculture, zacaton is one of the comparatively recent additions to the list of plant materials suitable for use in place of wood and rags in the making of paper stock of various kinds. Zacaton is a plant botanically known as *Epicampes macroura* Benth., a member of the grass family (Gramineae), which among the many natural families of plants contributes so largely to the wants and necessities of man. The Mexicans call this grass "raiz de zacaton," which means root of zacaton, the root being used locally, and also in this country, in the manufacture of brushes. The English-speaking people in Mexico and Central America refer to it as broom-root grass, wire grass and rice-root grass. The plant yielding this fiber is a common weed, growing very abundantly from Texas southward through Mexico into Central America.

It has been shown that zacaton is worthy of notice because of its capability of being turned to a useful account in the pulp and paper industry. From all accounts there is a sufficient amount of this material available within its commercial range of growth to supply a large part of the pulp needed annually in this country. The only question confronting the pulp manufacturers is the gathering of the crop and getting the material to the reducing plant without an expensive freight haul.

The root of the zacaton plant has a well-established commercial value, and it is estimated that between three and five million pounds are gathered annually. A large portion of this amount is shipped to New York at about 13 cents a pound. At the present time the tops of the plants dug up for the sake of the roots constitute waste material, and the Department of Agriculture has been directing investigations along this line with a view to discover, if possible, some practical method of using these tops for making paper pulp. That the investigations have been successful in this endeavor would appear from the above named Bulletin, in which the results of their tests are given. The conclusions arrived at by the Government officials are in part as follows:

The grass can be chemically reduced to paper stock by the soda process under less drastic and less expensive conditions than those employed for the reduction of poplar wood.

The well-known process, methods, and machinery employed for the manufacture of pulp from poplar wood are entirely suitable for the treatment of this material. In place of the wood-sawing, chipping, and screening machinery, a grass cutter, and possibly a duster, is required.

A production of 43 per cent of air-dry fiber from the air-dry grass is regarded as a very good yield, the fiber yield from poplar wood being from 46 to 48 per cent, and from esparto 43 per cent.

For bleaching the stock it has been found necessary to use more bleaching powder than in the case of poplar stock.

Paper manufactured from this stock has shown physical tests equal to those of a first-class machine-finish printing paper.

Death of Thomas Wallace.

THOMAS WALLACE, founder of one of the first companies to undertake the manufacturing of copper wire in the United States, died at his home in New York city on January 1st.

Mr. Wallace was born in Manchester, England. At the age of five he came to this country with his parents on the sailing vessel "New York." In 1839 his father established a wire mill at Annsville, N. Y., and in 1841 removed to Derby, Conn. In 1848 Thomas Wallace, in company with his brothers and father, founded the firm of Wallace & Company, one of the first to manufacture copper wire in this country. He is credited with having been the first to introduce the continuous wire machinery for drawing fine brass and copper wire.

Shoulder-Operated Artificial Arms and Hands

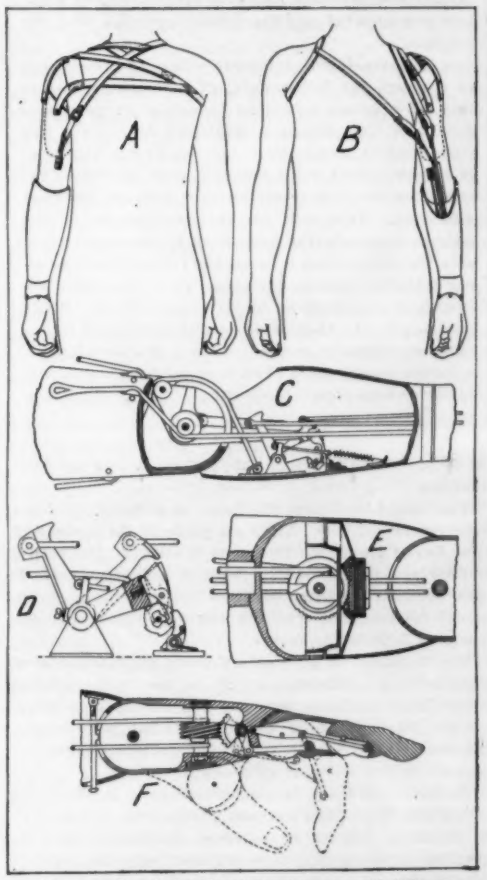
TO those unfortunates who have been deprived of their hands and arms through accident or otherwise, it would appear that aid in the form of artificial limbs is about to be realized. At least, the artificial limbs invented by William T. Carnes—an American who, some twelve years ago, lost his arm while operating a milling machine in a Pittsburgh shop and devised the improved artificial limbs during his convalescence—emulate the natural ones to such a striking degree that the handicap heretofore suffered by cripples is materially reduced.

An artificial arm invented by Mr. Carnes was recently exhibited at the International Surgical Congress held in New York, and the dexterity with which its wearer was able to perform different tasks was little short of a revelation. The artificial limb permits of the performance of all ordinary tasks, including the drinking of a glass of water, buttoning of shoes, tipping one's hat and, as an extreme example of its practicality, the carrying of a satchel weighing about 30 pounds.

In the Carnes artificial arm, fibre willow is used for the wooden portion, while steel gears take the place of joints and rawhide cords act as muscles. Each rawhide cord ends on a pair of suspenders fastened across the back and the chest, which furnishes the necessary tension. Thus the shrugging of the shoulder is made to control the arm and hand and the 240 parts of which they are composed. The rawhide muscles move the steel joints, and the unison that obtains makes the action of the arm almost natural. The elbow is bent with a simple forward movement of the stump which, by means of the cord attached from the forearm to the shoulder suspender, raises the hand as high as the wearer wishes—high enough to take off his hat or brush his hair, if so desired. A downward movement of the shoulder causes a slight tension on another rawhide cord controlling the fingers, which results in bending the hand backward from the wrist joint and the opening of the fingers. Another shrug of the shoulders closes the fingers and locks them so that they tightly grip the object that is being handled, from a toothpick to a valise. Repeating the downward movement of the shoulder causes the fingers to be unlocked. The wrist is provided with a hinge joint and a button and can be locked securely in three positions. If desired, the button can be pushed back and the wrist flexed automatically by means of the cord which opens and closes the fingers. All the work is done by the shoulders. Raising the elbow moves the wrist one third of a turn.

The accompanying line drawings depict the more important features of the Carnes artificial limbs. At *A* and *B* are shown the back and front views, respectively, of the shoulder harness or straps and how they are worn. The straps are so arranged that by slightly varying shrugs of the shoulders the rawhide cords actuate the arm and hand in the desired manner. At *C* appears a sectional view of the arm, in which the three cords appearing at the left are, in the order shown, the finger control cord, the wrist cord and the elbow cord. The pivot appearing at the center is the elbow pivot. The two cords at the extreme right are the finger operating cords. An enlarged view of the lever mechanism of the arm appears at *D*. At *E* is shown the bevel gear mechanism which serves to turn the wrist, while at *F* appears the hand member.

Buttoning a shoe with an artificial hand



Constructional details of the Carne artificial arm and hand

A Sixty-Cycle Million-Volt Transformer

By Harlan J. Eveleth

PUBLIC demonstration of the phenomena associated with high tension electric current attracted considerable attention during the closing week of the Panama-Pacific Exposition at San Francisco. Problems confronting the transmission of power at unusually high tension over long distances were investigated; in fact, the experiments were performed to ascertain the feasibility of transmitting 500,000 horse-power at a tension of 500,000 volts over a distance of 2,000 miles. Contrary to the prevailing impression, the installation of the apparatus was not primarily for investigating the effect of an intense electric field upon the dissipation of fog, but numerous experiments were tried along that line when conditions were favorable. At the time of writing the research was incomplete and no specific results had been announced.

The transformer employed in the research was designed by Mr. C. H. Thordarson, of Chicago, and installed at the Exposition at a cost of $30,000. Current is obtained from the mains of the Pacific Gas & Electric Company at a potential of 2,200 volts and is transformed to approximately 1,000,000 volts at the secondary terminals. The maximum rated capacity of the transformer is 1,000 kw. The secondary or high tension coil is wound with 90 miles of aluminum ribbon and is divided into 190 sections or "pies," each section having an external diameter of about 4½ feet, an internal diameter of about 4 feet, and a width of $^{3}/_{16}$ inch. The aluminum ribbon is ⅛ inch in width and about $^{1}/_{600}$ inch in thickness, and the layers of each section are separated one from the other by three layers of paper ribbon impregnated with an insulating compound; nearly 1 $^{3}/_{4}$ miles of paper insulation being employed per section. These sections, designed to generate a current of 5,300 volts potential each, are banded both inside and out with copper ribbon, which in addition to facilitating the connections of the terminals of the winding, safe-guards the coil from high potential surges. The various sections are separated by a distance of $^{3}/_{16}$ inch, and the 190 sections occupy a space of about 6 feet. They are connected in series and one terminal of the assembled secondary coil is grounded.

The primary or low tension coil is wound with copper ribbon and is divided into 122 sections which are connected in multiple-series across the 2,200 volt mains. The neutral taps are grounded to the frame of the transformer. Insulation between the primary and secondary elements is maintained by a specially prepared paper tube, weighing nearly one ton, inserted between the two. Four hundred miles of copper, aluminum and paper ribbon are used in the construction of the primary and secondary coils and the paper tube. The transformer is immersed in 225 barrels of petroleum oil, the whole being contained in a huge, V-shaped structure of concrete set into the earth. The total weight of the transformer alone is about 15 tons. Secondary sections cannot become short-circuited nor is it deleterious if adjacent sections flash-over, for the nature of the dielectric medium is instantly self-restoring. The constructive features of the transformer are such that sudden internal stresses tend to compress the secondary sections toward the center, parallel to the core; not to disrupt, as usual. These advantages, together with that of lightness of weight, are now being incorporated in a similar type of construction in transformers of commercial magnitude.

The building wherein the million-volt transformer is housed was erected at a cost of $6,000. It is 75 feet long by 30 feet wide and 2½ stories high, and the open ends, through which the high tension leads from the transformer pass out, make it appear very much like a Zeppelin hangar. Its construction is unique in that it is held together entirely by iron bolts which run parallel to the high tension wires within, for the danger of fire due to electro-static stress had to be carefully avoided. The switches, circuit-breaker, measuring instruments, etc., used for controlling the primary current and determining the power consumption, are situated in a corner of the building and are, together with the operator, inclosed in a grounded metallic cage which shields them from inductive effects.

Outside of the building is located an aerial net of wires, measuring 50 feet square, suspended 35 feet above the ground by ropes running from the four corners to telegraph poles. One of the secondary terminals of the transformer is grounded while the other is connected to the net by means of wires which are brought out through the open ends of the building. Beneath the net and on the ground are devices for collecting a portion of the current dissipated from the net, and midway between the earth and the net is a screen of rope to protect life in case the highly charged net should fall when persons were standing beneath. At a pressure of 1,000,000 volts, 400 horse-power in energy is required to fully charge the net, and it should be remembered that this current is at a frequency of 60 cycles instead of 60,000 cycles, and therefore must be employed with the utmost caution. All high tension leads are suspended by lengths of rope which have been thoroughly impregnated with an insulating material to keep out the dust and moisture. A metallic cage is placed over each juncture of rope and wire to prevent disintegration of the insulating compound due to the brush discharge which would otherwise occur at the juncture; in fact, if the cage were not present the rope would probably be heated sufficiently to cause combustion to take place. The insulation of such high tension current was one of the important problems to be solved.

A large horn gap is used in conjunction with the net to observe a direct discharge from the net to ground. Resistance, in the form of a jet of water, is inserted in the high tension circuit to prevent a short-circuit of the secondary coil, which would otherwise result. The horn gap is constructed of two 10-foot lengths of ¾-inch gas pipe, and the length of the gap can be varied by manipulating a cord which passes through the wall of the building into the metallic cage wherein the operator is standing. One electrode of the gap is permanently grounded and the other may be connected to the net at will. The voltage at the gap, due to the combination of the net and the transformer, is considerably over 1,000,000 volts, and a highly luminous arc, from 4 to 5 feet in length, showing heavy frequency bands, is the characteristic type of discharge. The accompanying noise can be heard to a very great distance. The sudden make and break of the arc so affects the electric field between the net and the earth

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Two men who are using the newly devised artificial arms

Industrial Preparedness for Peace

The Meaning of National Efficiency

By Miner Chipman

IT is much easier to put under motion a nationwide propaganda for military preparedness than it is to arouse a corresponding public interest in the problems of industrial and commercial preparedness. The reason is a simple one. Military preparedness has a patriotic appeal, it touches the individual's tender spot of nationalism. When men speak of military preparedness, they talk about "Our Navy," and "Our Army." Every man, no matter what his business may be, considers himself a preferred stockholder in "Our Navy." On the other hand, when we discuss industrial preparedness for peace, we lose the glamour of patriotism, and it becomes a matter of his business, your business and my business. We delegate, through our representatives, the planning and carrying out of an adequate program for military preparedness. Industrial preparedness for peace cannot be delegated. It is your job and my job. The banker, the broker, the manufacturer, the worker, the merchant, the consumer, must all be conscripted into the army for industrial preparedness.

National Efficiency

On December 8th, President Wilson, in a joint message to the houses of Congress, concludes with an appeal for measures to mobilize the industries and resources of the country. He said: "For what we are seeking now, what in my mind is the single thought of this message, is *national efficiency* and security. We serve a great nation. We should serve it in the spirit of its peculiar genius. It is the genius of common men for self-government, industry, justice, liberty and peace. We should see to it that it lacks no instrument, no facility or vigor of law, to make it sufficient to play its part with energy, safety and assured success. In this we are not partisans, but heralds and prophets of a new age." What does the President mean by *national efficiency?* What is it to be efficient?

The mechanical engineer's definition of efficiency is the ratio of result obtained to effort expended in obtaining that result. The engineer devised his measurement of efficiency through experiments in the physical world of energy. He developed a conception of units—the B.t.u., the foot-pound, the horse-power, the volt and the watt. If the nation were made up entirely of physical forces we might apply the engineer's principle of mechanical efficiency. But it is not so. The nation is made up of human beings whose ideals and aspirations cannot be measured in foot-pounds or kilowatt hours. A pound of coal contains just so many heat units, a determinable quantity of dynamic energy, but who shall place a limit upon the ideals and aspirations of a people? It is essential, therefore, that we define what we mean by *national efficiency*. A definition of national efficiency that would satisfy Imperial Germany would not, and could not be accepted by the United States. By whatever name we may care to call it, scientific management or imperialistic-socialism, it does not matter, our democratic spirit rejects efficiency at the price of individual liberty and initiative.

The worn out business man is invited to the Country Club for luncheon. He is invited to play a game of golf. He has never had a stick in his hand. He plays. He spends 80 per cent of his time in a bunker. He plays exceedingly bad golf. As an efficiency proposition, ratio of result obtained to effort expended in obtaining that result, he has been a dismal failure. He goes home, tired and a little sore, but he is filled up with good wholesome air, his joints are loosened up, and for a week or more he has a new grip on life. The efficiency of that afternoon at the Country Club is not measurable in the terms of golf, but in the terms of exercise, good health, and new ideals. He takes a new interest in life, joins the club, and becomes a crack golfer. He adds ten years to his life. How shall we measure the efficiency of that afternoon in the bunker? Machine efficiency is a static thing. We measure the efficiency of a particular performance; we cannot put ideals into a combination of cogs and cams. The ideal of the builder is there, but it is static, it cannot grow, it cannot change. We do not measure the efficiency of a phonograph by standards of performance found in a sewing machine, or in the terms of the family wash. We cannot conceive of the phonograph's suddenly taking on the functions of a sewing machine. With men and with nations it is quite different. The rail-splitter becomes the president of his country, the farmer boy becomes the director of the railroad. Agricultural Germany becomes Industrial Germany. Failure condemns a machine, but the failure of men gives birth to new ideals and new aspirations. Organized labor has opposed scientific management, and still opposes it, because it is felt that this difference has not been realized.

Miner Chipman was employed by Harrington Emerson in New York several years before the Efficiency movement had taken hold of the industrial world. As an assistant to Mr. Emerson upon large and important work, he received his experience and knowledge of the principles of scientific management. However, Mr. Chipman has specialized on the human element in industry. He attained considerable public prominence when he was engaged by the employees of the United States Government at Watertown Arsenal, Watertown, Mass., to make a study of scientific management in its relation to the laboring man. This study occupied a year of careful investigation. The discontinuance of scientific management in Government shops was contrary to Mr. Chipman's recommendations. He found that the workers were not opposed to efficiency or the principles of scientific management in itself, but were opposed to arbitrary methods of introducing it, and the dictatorial manner of administering the system. The brief prepared by Mr. Chipman is considered to be the most thorough and exhaustive study of scientific management and the human equation thus far prepared.

It is impossible to compress within the few words of a slogan the full meaning of a campaign, and in this introductory article on Industrial Preparedness for Peace, Mr. Chipman endeavors to explain just what kind of preparedness the SCIENTIFIC AMERICAN *is urging. It is not a plea for shop efficiency, but something far bigger and broader, namely, National Efficiency. This calls for the development of our natural resources, the utilization of our waste products, the coöperation between our manufacturers and our technical schools, the elevation of the entire nation to a higher plane of intelligent effort. While efficiency in the shop plays an important part in our national efficiency, we do not urge a campaign for scientific management that does not take cognizance of the human element.*—EDITOR.

The ideals that form the basis of national efficiency are very real things. They are made of the same stuff that forced itself into the great Northwest and turned buffalo pasture lands into fields of golden wheat. It was not the *now* that impelled those pioneers of national efficiency, it was the force of ideals and unbounded faith in the *future*.

The definition of *national efficiency* implies empirical standards of performance. It is the ratio existing between an equitable standard and an actual achievement. The sum total of our national performance divided by the sum total of our national standards represents our *national efficiency*.

National efficiency is measurable only in the units of its structure. If there are groups who prefer sloth to industry, leisure to progress, immediate gain to permanent prosperity, then we must pay the price of inefficiency.

Legislation and National Efficiency

It is almost a platitude to say that laws enacted in behalf of the nation's industries should be of such character as to support the greatest number of industries, and provide the means for healthy growth and permanent prosperity. As an ideal this platitudinous principle is all very good, but in a great democracy wherein legislation is enacted by the representatives of clamoring constituencies, it is difficult of attainment. Inasmuch as we have pinned our faith in democratic principles and democratic forms, we must look to Congress to enact such laws as will give our industrial and commercial life an adequate opportunity for preparedness to meet any contingency.

We must look forward to constructive legislation. The Government must remove all obstacles in the path of national prosperity. The road to preparedness needs rolling, not plowing. The paths of business need tamping not tampering. The highway of national efficiency must be wider than a "pork barrel."

There are many who would solve the problem of industrial preparedness for peace by instituting a high protective tariff. There is no panacea for national efficiency. A protective tariff may breed inefficiency. It may protect the weak and allow them to grow fat with prosperity, and so fatten the strong that they will loll in the security of inefficient obesity. There are those who believe free trade will be a cure-all for our industrial troubles. Many believe we can float along and trust in Providence and good luck to save us from disaster. Others view the future with utter indifference. They look upon our future economic and sociological problems as our grandmothers looked upon measles and mumps—necessary evils, the sooner over the better. The problem of industrial preparedness for peace, although largely dependent upon national policy in relation to legislation, does not relieve the individual citizen of his full quota of responsibility.

There is a vast field of activity, research and development open to all interested in our industrial, commercial, and social progress. Entirely aside from political and legislative opinions, the responsibility for *Individual Efficiency* remains the important problem. If we can mobilize the forces of our national society for industrial and commercial security, with the same intensiveness and spirit of patriotism which accompanies preparedness for war, we may look into the future with calmness and faith.

Business Efficiency

In a subsequent number of the SCIENTIFIC AMERICAN we shall discuss the problems of *Business Efficiency* in so far as they concern industrial preparedness and national security. We must be more than efficient producers; we must be efficient consumers. The great mass of humanity making up the nation's labor force must be mobilized for national industrial security. It behooves us to get together and settle our differences in a spirit of democracy. We must be able to appreciate the ideals and aspirations of the whole people, and stamp out the infectious theories of class. We must put away our favorite Utopias for a time, and look the present fully in the face, and await the future struggles fully mobilized. We shall not devise "systems" by means of which all our problems may be solved. We shall endeavor to look into the probable contingencies of the future and outline practical means and methods of survey and examination. If we can get close enough to our problem to pick it to pieces and analyze its factors, the complexity of it all will not discourage us.

Factors of Efficiency. A little while ago the writer was called in to determine the factors of efficiency in a large New York department store. For several weeks the task looked hopeless. The endless amount of detail, the tremendous number of variables, the multitude of functions—all of these things appeared as a confused and meaningless process. Each and every department in the great store had its own problems. A technique peculiar to itself existed behind each counter. The whole world of art and industry was mobilized for the consumer. All the way from an Oriental rug at $20,000 to a paper of pins at five cents, there ranged an infinite variety of merchandise. Back of the salespeople, behind the scenes, we found the great army of helpers—stock-girls, clerks, deliverymen, porters and scrub-women. By analysis and observation we discovered certain clearly defined streams of activity within the store. We began to define functions and examine responsibility. Instead of looking at the store as a whole, we examined its parts with a microscope. We found that the great department store, as an organic whole, was made up of an infinite number of tiny cells, so arranged and functioned as to render service to the whole. In a general way the problem divided itself into four major propositions, viz.:

I. The Consumer.
II. The Human Factor (Personnel).
III. Merchandise.
IV. Capital and Expense.

This vast machine, made up of nicely adjusted parts, was operated for one purpose, and that purpose founded upon one ideal: "Service with satisfaction to the consumer and profit to the merchant."

Scientific Management and Preparedness

By scientific management we mean method, not system. Scientific management means a viewpoint and not a cure-all at $5.00 per bottle. Scientific management is for the man who can have a standpoint without becoming a standpatter. We shall look upon scientific management as that type of management which aims to discover basic causes, procure adequate evidence of fact, appreciate men as well as machines, and, above all else, realize that in America business and democracy are inseparable. The exponents of scientific management must realize that they are not handling inanimate things when they deal with the

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Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Right-hand Rotation

To the Editor of the SCIENTIFIC AMERICAN:

There is a very common phenomenon in physics that seems to be badly confused in our text books. I refer to the direction of rotation of the plane of polarization, when plane polarized light is passed through such a substance as cane sugar. Cane sugar, we know, rotates this plane to the right, but the question might well arise in any student's mind, as to what direction this really means. The few following quotations will make my point clear:

(1) "Further, some specimens of quartz rotate the plane of polarization to the right (looking in the direction of propagation of the light) and some to the left. The former are called right-handed, or dextrogyrate, and the latter left-handed or laevogyrate."—Preston, *Theory of Light*, 4th ed., p. 437.

(2) "Among crystals of quartz there are some that rotate the plane of polarization from left to the right of an observer receiving the light . . . the former are called right-handed. . . .—J. Walker, *Analytical Theory of Light*, p. 344.

(3) . . . manchen Kristallen nach rechts (für einen den Lichstrahlen entgegenblickenden Beobachter der Bewegung des Uhrzeiger gleichsinnig), bei anderen nach links gerichtet, so dass man Rechts—und Links—Quarz zu unterscheiden hat."—F. Pockels, *Lehrbuch der Kristtaloptik*, p. 294.

(4) "Die Drehung kann nach rechts oder nach links erfolgen, wobei man diese Richtungen vom Beobachter aus zu rechnen pflegt, welchem sich der Strahl nähert. Dementsprechend heisst die Substanz selbst rechtsdrehend oder linksdrehend; . . ."—O. D. Chwolson, *Lehrbuch der Physik*, Vol. 2, p. 1002. (Trans. from Russian.)

(5) "Pour définer le sens de la rotation, on considère un observateur couché le long du rayon lumineux, les pieds tourné du coté de la source. S'il voit le plan de polarisation tourner de sa gauche vers sa droite, le corps qui produit cette rotation est dit *droit* ou *dextroguyre*."—G. Foussereau, *Polarisation Rotatoire*, p. 4.

(6) "Es giebt Quarzkrystalle, welche die Polarisations-ebene nach rechts drehen (von der Seite des Beobachters im Sinne des Uhrzeigers), und andere, welche die . . ."—Verdet, Wellentheorie des Lichtes, Vol. 2, p. 194. (German Trans. from the French.)

It is not necessary to multiply illustrations. The above examples, taken from English, French, German, and Russian texts, ought to suffice to make the point of this communication clear. It may be mentioned in passing that the two standard text books in optics for American students, Wood and Drude, simply state that in right-hand rotation the plane is rotated to the right, which is, to say the least, rather indefinite.

Turning briefly to the quotations above, number one is perfectly definite, and incorrect. Number two is definite and correct, as are also numbers three and four. In number five we have an elaborate attempt to make the matter clear, but it depends altogether whether the observer is lying on his face or his back, and which way he has his head twisted. Number six is correct, but not quite so clearly put as some of the others.

The correct definition of right-hand rotation seems to the writer to be the illogical one, for when one turns to the right he means that he turns toward his right hand as he progresses. It is otherwise with the definition of the direction of rotation of the plane of polarization. A rotation to the right is defined as a clockwise rotation, when the clock is viewed from the front, that appears to an observer looking not along, but against the direction in which the ray is being propagated.

This may be a matter of small moment, but when one considers that practically no text book in English (with the exception of Walker's, noted above, and excepting an article by the same author in the *Encyclopedia Britannica*) has this matter stated either definitely or correctly, and when one considers further the importance, both practical and scientific, of this phenomenon, there seems, after all, some excuse in calling attention to it.

L. P. SIEG, Ph.D.
Asst. Professor of Physics, University of Iowa.

Giant Kew Pineapple

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue of your paper I read a letter from Sarawak, regarding the Giant Kew pineapple. In 1891 I imported some of these plants from Heneratgoda, Ceylon, and about the same date Mr. G. C. Matthams, a neighbor, obtained some from India also. They proved to be what we had been propagating for years in Florida under the name of Smooth Cayenne. This variety has been gradually discarded for open field culture so that now I don't believe one could find an acre left on the entire East Coast. The reason is that while it is large and of superior quality, the fruit does not ship or keep so well as the Red Spanish, and the plant is more subject to the pineapple disease. Some acreage is still being grown on the West Coast, where shedding is required to keep off frost. In the latter part of the last century large quantities of these plants were shipped to the Hawaiian Islands, where they have formed the nucleus of an extensive canning industry. At the time these were sent away, the out-of-door growers on the East Coast had already concluded to discard this variety for the Red, and were glad to dispose of their plants.

JOHN BEACH.

West Palm Beach, Florida.

Increasing Our Means of Defense

To the Editor of the SCIENTIFIC AMERICAN:

Many ways have been suggested by experts and laymen for enlarging the Army, and for adding to the strength of the Navy, but no ways have as yet been recorded that are acceptable to all.

Our Army is the smallest in proportion to the area and wealth of the country of any army in the world. Our little Army, however, is as efficient, man for man, as any, and is always in training for any emergency. The same may be said of the Navy. As to the National Guard, the people of the different states judge the whole guard of the country by what they see of it in their own state, city or town. The United States Army officers who are detailed to inspect and instruct the National Guard are doing everything in their power to make these troops as efficient as possible. The Naval Militia is small in number, as compared to the National Guard, but is well trained in many of its duties.

The volunteers in all branches of the service have always given good account of themselves when called upon by the President, as the history of the country will tell.

In recent years it is apparent that many people seem fearful of the consequences of having marines and sailors land in foreign countries to protect the rights of their country. The promptness with which the armed forces (or police) are used when necessary, is what produces the desired effect, and makes them command the most respect, and at the same time preserve the respect for their country's flag.

There was a time when military parades would pack the streets with spectators from curbs to house lines, but now there is often but a thin line of onlookers along the edges of the sidewalks, on these occasions.

The troops are not to blame for the scarcity of enthusiasm among the citizens, as they are better than ever in point of efficiency, appearance and in numbers.

It is the citizen that is lacking in spirit, and this lack of spirit has been gaining year by year, for some time. There are many able-bodied citizens of eligible military age, who would feel as constrained and uncomfortable in the Government olive-drab, as they would in another style of uniform furnished by the Government and states of a material with a horizontal pattern. Many would join some military organization, no doubt, if they could become officers at once without having to climb the ladder to earn their shoulder straps. If one learns early to obey, he will be the sooner able to command.

It has been a surprise to many to see the numbers who have never had military training volunteer to serve at the Plattsburg Camp of Instruction, and similar camps, and spend a month in Army uniforms, in vigorous training and learning the first lesson of a soldier. May their example be followed by many others each year. Such camps should have been started years ago before the present war cloud settled upon the earth.

The men trained at these camps should keep their uniforms, and organize into bodies of "Minute Men." The Minute Man of the American Revolution had his flint-lock, powder-horn, bullet-pouch, and haversack, and was ready at all times when his services were needed by his country. In those days, about all that many could offer was their willing assistance, but few were thoroughly trained in the manual of arms, tactics and well disciplined. The Modern Minute Man should be "trained to the minute."

For many reasons it would not be advisable or necessary for members of such organizations to personally own a military rifle, these should be the property of the Government, and kept in arsenals ready for use, but the service uniform (which should fit the wearer) and equipment, consisting of hat, coat, breeches, shirt, leggings, shoes, cartridge belt, haversack and canteen could be the property of each man. The equipment mentioned, but not including the shoes, will cost $14.50, which is less than most outing suits will cost, and it will be serviceable for several camp tours with proper care.

The enlisted men of the National Guard are furnished with field uniforms free of charge.

As the numbers of men who have received military training increase, the feeling that many people have that when a number of men are gathered together in uniforms fully equipped, it is a declaration of war, will gradually wear off, and slowly but surely the public in general would consent to an increase in the numbers of our country's defenders.

The days of the steel and masonry forts have passed. We are back again to the days of earth-works. Heavy earth-works as enduring as the hills should be built to guard the coasts. Where fortifications can be placed in good positions behind natural hills over which the guns could shoot, it should be done.

The highways and railroads of the country could be utilized for military purposes, and where necessary, to make the systems complete for military purposes, a continuous line parallel with the coast, and at a convenient and safe distance from it could be built with radial lines running inland to bases of supplies. These bases in turn would be similarly connected with large reserve supply depots farther inland. By having such a system for convenient travel, troops, heavy and light artillery, and the necessary ammunition and supplies could be rapidly sent to any point. This, too, would allow a smaller number of troops to defend the country on account of the rapidity with which they could be sent from place to place where most needed.

No doubt our military leaders have some such scheme for protecting the country, but they should be authorized to carry out their plans.

Fort Columbus on Governors Island in New York Harbor was built with the assistance of students of Columbia College in the year 1809. Our reserve troops could assist in building the military roads, railroads and fortifications, nearest their homes, and placing the guns as part of their duties.

All men in the reserves would not be required in the field; many would be required in arms and ammunition factories, and others employed upon uniforms and equipment. Those so employed by the Government in case of war should get credit for their work in serving their country as do those in the field.

There is use for practically every trade and profession in military and naval service, so there is for unskilled men and the deserving unemployed.

Every factory owner should ask: "How can I best adapt my factory for use in making war supplies?" The War Department should have experts who could answer the question, and furnish plans for making plants suitable for use in case of war. The trained mechanics of the reserves could be employed to make the necessary changes required by the plans of the experts.

Meeting places for those who wish to take up military training should be found throughout the country and instructors appointed. Certificates of proficiency under the several branches of instruction should be issued to the students, and they should also receive badges for marksmanship like those issued in the Army and Navy. Instructions should be given in every branch of the service, including sanitation, cooking and transportation; and in addition, practical work should be conducted in the field during each year of the service.

The National Guard organizations are authorized to organize what is known as Depot Battalions as auxiliary troops, and it should be possible to make use of the armories for meeting places and for drilling the reserve troops under this rule.

The boy-scouts who are getting excellent training that helps to make good citizens and soldiers, could join the reserve troops or National Guard when they reach the age of 18, the minimum age for enlistment.

A military training goes a great way towards making a better citizen, and every able-bodied citizen should be willing to receive such training for his own and his country's good. Incidentally, if military training and discipline were more general there would be less danger from panics at fires and where large numbers of people are assembled. The traffic regulations used in city streets are nothing more or less than thorough practical applications of military order and discipline.

The prescribed ages of men elegible for military service are from 18 to 45, and all citizens should do their duty towards their country and state at some time of their lives. During the time of peace everyone should perfect himself in some way so as to be useful in time of war.

Those who have served their state and country in time of peace or war, have always a feeling of great and continued satisfaction for having done that service.

GEORGE P. PERRINE,
Captain 71st Inf. N. G., N. Y.

Ford tractor, equipped with wheels for road work, hauling a farm wagon

Gas tractor hauling a disk harrow through a ploughed field

Light-Weight Gas Tractor for the Farm

ALTHOUGH circumstances resulted in his entering the business of manufacturing motor cars, it is said that the earliest ambitions of Henry Ford were to build a light-weight, inexpensive gasoline tractor for the farmer, and ever since driving a steam engine on a Dearborn farm some thirty-four years ago, he has cherished the idea, despite his successes in automobile manufacturing. At last his idea is coming to be an accomplished fact.

For the past three years the Ford tractor has been under construction and in practical operation, it being the intention of the designer to thoroughly develop the machine before placing it in the hands of the farmer. In other words, it will only be offered when it has outgrown the experimental stages.

The tractor shown in the accompanying illustrations represents the realization of Mr. Ford's long cherished idea. It is equipped with the regular 20-horsepower motor used in his motor cars, and has a frame constructed of special vanadium steel, which gives it the advantages of extreme toughness, durability and light weight, the last named feature being of paramount importance. The tractor weighs but 1,500 pounds, permitting of its use over the softest ground.

The one striking feature of the Ford tractor is that, instead of being extremely heavy and complicated in construction, it is little more than a clever adaptation of the light-weight motor car plant to a small but powerful chassis, the wheels of which can be changed according to the nature of the work at hand. With an average fuel consumption of one gallon per hour, the tractor has a working speed of from two to four miles an hour, and can draw a heavy load on the road at twenty miles per hour. A new type producer is used, which utilizes the exhaust heat to change the liquid fuel into gas. Any fuel which boils below 550 degrees Fahr. can be used, among them being gasoline, California distillate or kerosene. As gas is used for fuel, there is no smoking, and the spark plugs very rarely have to be changed.

The influence the new tractor will have on the work of the farmer—particularly the small farmer, whose needs are not catered to by the larger gas tractors—is certain to be great. Although the new tractor is said to do the work of four horses, its initial cost and upkeep for a year is less than the initial cost and upkeep of one good horse for an equal period. The advantages the tractor possesses over the horse are many, among the more important being the following: The tractor does not consume "food" or fuel when not at work, hence in inclement weather and during the winter months there is no upkeep cost; it does not overheat while at work, even on the hottest days, and, unlike the horse, it does not have to be rested every half-hour because of excessive heat; the flies do not bother it; it does not break out of the pasture and get into a cornfield and overeat, nor lie down and die; wherever the driver leaves the tractor he is certain to find it standing where he left it and not engaged in eating leaves from the hedge fence, and, finally, the tractor does not become frightened and run away. These are but a few of the points in favor of the tractor from the farmer's viewpoint.

The following contrast between the work of horses and the tractor is of interest:

A DAY'S WORK.

Two horses	6½ acres.	Always whether at work or idle.
" "	32 quarts of oats.	
" "	hay and bedding.	
" "	2 hours labor.	
Ford tractor	13½ acres.	When at work; idle it costs nothing.
" "	10 gallons of gasoline.	
" "	1 gallon oil.	

The main application of the tractor on the farm is naturally and obviously the hauling of agricultural implements over the fields and the transportation of products to market or shipping point. The experimental tractor has proven successful in ploughing, in hauling a double disk harrow and in cultivating corn; in reaping wheat with a battery of seven Ford tractors, in which instance each tractor pulled a binder with an eight-foot knife; in harvesting wheat, and in hauling a 6,700-pound drill over a distance of 135 miles, during which journey the trailer broke down. On the other hand, the tractor is available for every kind of trucking on good roads and bad roads about the farm and cross-country. One of the new tractors and two trailers accomplish the work of two heavy trucks and last longer, cost less to maintain and the first cost is less than the cost of one truck.

That the day of emancipation of the farmer is at hand appears a certainty, for much of the hard labor heretofore associated with agricultural pursuits is to be taken care of by the new tractor.

Ploughing a field with a heavy plough drawn by one of the new farm tractors

The Automobile Show

THE annual automobile show has always been immensely popular in New York, and both those who have and those who have not turn out each year with equal enthusiasm to inspect and criticise the new offerings by the trade. That the automobile should arouse such universal interest, not only in New York but everywhere else, is not surprising, for it embodies the spirit of the times in a way not found in any other single structure—the hustle, excitement and the get-there spirit so characteristic of to-day; and it is hardly necessary to add that the 1916 show was a complete success. Eighty-seven makers were represented, and they exhibited over three hundred cars, covering a very wide variety of models and sizes.

From every point of view the present exhibition was by far the finest that has yet been staged. Every well-known car was adequately represented, and the artistic excellence in design was practically universal and notable for the high standard attained. It is true that in fundamental features there was a striking similarity throughout the halls, but the excellent taste displayed removed all impressions of monotony, and there was sufficient individuality in detail to meet the requirements of those who desire distinctive features. In mechanical perfection the same progress was everywhere in evidence in the carefully finished designs that mark the work of the scientific engineer. The accessory section of the show gave the same impression of progress, for there was a noticeable absence of freaks, and the great majority of the multitude of articles shown were of undoubted utility, well and substantially made.

The features of the show were the multi-cylinder engines, the increased comfort indicated in every detail, and the decrease in weight; and to these points should be added the general tendency to a decrease in prices. Of course, the great novelty was the new twelve-cylinder engine, which won general approval on account of the careful working out of designs and details, which gives confidence in their satisfactory operation in the hands of the general public. Six of these remarkable engines were to be seen among the exhibits, while of the eight-cylinder machines that made their appearance last year, and which have met with such great favor, there were several new recruits this year, and this model still holds attractions as a novelty. However, the makers who pin their faith to the well-tried four and six cylinder engines have not been idle; for many, by carefully revised designs and improved methods of building, have been able to secure increased engine speed, with an accompanying increase in power and flexibility that makes them extremely satisfactory to all but the hypercritical. Excellent examples of such engines were seen among the cars shown, and there is slight possibility that the fours and sixes will lose the position they have held so long and successfully.

Besides the study that has been given to the motors, considerable attention has also been given to the gears and transmissions, and it was very noticeable how greatly the size and also the weight of these essential parts has been decreased, largely by judicious selection of materials.

The same study of materials generally has resulted in material decreases in total weight in the case of a number of cars, usually accompanied by increased strength and stiffness, and this is a point worthy of consideration by purchasers, as the less dead weight a car has to carry the longer its life.

There is a general tendency to extend the electrical equipment as a regular part of the outfit, the electrical starter being almost universal, while generator sets for lighting are rapidly becoming more common.

Although not new in principle, the latest development of the electric drive may be classed as among the notable features of an unusual exhibition, and undoubtedly marks an important departure from current accepted practice.

Body design and construction, as seen in this exhibition, has reached a high state of excellence, a simple elegance being the characteristic that is very effective. Long, easy flowing lines, with a minimum of sharp corners, are predominant, and although the majority of the cars shown were in black, there were numerous examples of quiet tints that are exceedingly attractive. Great ingenuity was shown in the seating arrangements, the divided seat being conspicuous, while various arrangements of offset seats add greatly to the comfort and the capacity in many cases. Convertible bodies were an important development that adds to the usefulness of the automobile.

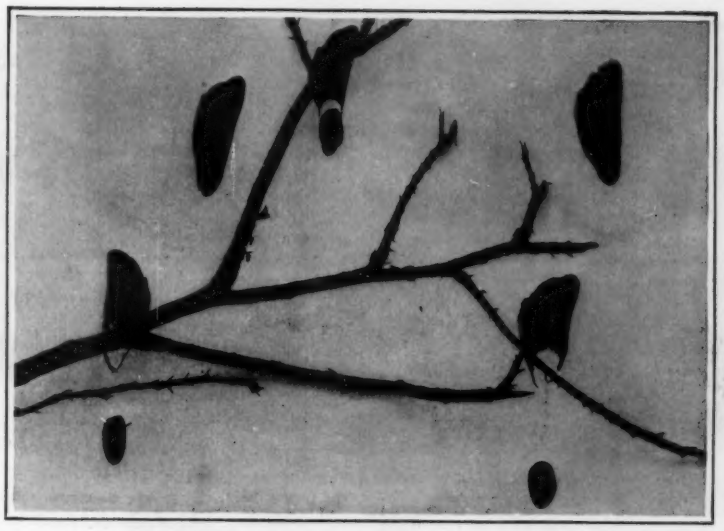
Among the numerous classes of exhibits shown in the accessory section particular attention was attracted by tires which show results of constant study and experiment in their improved durability and comfortable riding.

Taken as a whole, the Sixteenth Annual Show can be rated as the most notable in the history of these events and an instructive revelation of the possibilities of scientific engineering and modern methods of production.

Nature's Bomb Dropping from Aircraft

By S. Leonard Bastin

THERE must be very few human inventions that have not been forestalled by Nature. Nowadays when all the world is talking about the wonders of bomb dropping from aircraft it is interesting to consider that the same thing has, for untold ages, been carried out by plants. In the case of not a few plants, where the seeds or fruits have a wing-like or a parachute attachment, special arrangements are made for the dropping of the burden in certain circumstances. Thus, if the winged seed of a pine knocks against the branch of a tree, or is stranded anywhere, the membranous wing at once becomes detached. The heavy seed is no longer supported and it at once falls to earth. In the fruits of many thistles a similar plan is to be observed. The fluffy parachutes float about in the air for a considerable time and may travel a considerable distance. The moment one of these strikes against an obstacle or is hung up in any position, the fruit at once is severed from its supporting parachute and naturally falls to the earth. Without a doubt this dropping of fruits and seeds accounts for the fact that by the side of walls and hedges there are to be found so large a number of plants bearing seeds which are dispersed by wind agency. The processes knock up against the obstacle and the seeds drop to the ground beneath.



A curious anticipation of bomb dropping from aircraft is seen in the flying fruits of the California pine

The fruits of many thistles drop their seeds when they brush up against a branch

Probable Perception of Invisible Light by Some Animal Species

By J. Fidel Tristan and Gustave Michaud

Costa Rica State College

MANY animals can emit sounds either higher or lower in pitch than those utterable by man. The same differences have been observed in the organ of hearing, some insects being able to detect sounds of such a wave length as to be inaudible for man. It is perhaps generally and implicitly admitted that no such differences exist in the perception of light of different wave lengths throughout the animal kingdom, and that all eyes, whether small or large, simple or complicated, are keyed exactly to the very same scale of wave lengths which man is able to perceive, yet we fail to find anywhere any proof in favor of such an assumption. On the contrary, the extreme diversity in the anatomy of eyes—in the general plan as well as in the details—added to the fact that some eyes are more complicated and even more perfect than ours, those of birds, frogs and dragon-flies, for instance, just as the nose of dogs is more perfect than that of man, make it probable that some species can see beyond one extreme at least of our visible spectrum while being perhaps insensible to the other. In other words, while some species may not see the extreme violet they may perceive some of the spectral region which follows the extreme red, *i. e.*, the infra-red. Again, other species which may be insensible to the extreme red probably readily perceive some of the ultra-violet. Some very clever experiments made by Sir John Lubbock seem to give a firm foundation to the latter hypothesis, so far as ants are concerned. Says the English naturalist:

"This seems to me strong evidence that the ultra-violet rays are visible to the ants. . . . Now, as every ray of homogeneous light which we can perceive at all appears to us as a distinct color, it becomes probable that these ultra-violet rays must make themselves apparent to the ants as a distinct and separate color (of which we can form no idea)."

It is easy to see that such a shifting, upwards or downwards, as the case may be, in the scale of perceptible wave lengths would be extremely useful to some species. We have shown recently that photographs made in infra-red light reveal with a wonderful clearness the smaller details of far away objects. Birds which rely, for the finding of their food, exclusively on the vision of very distant objects (vultures and other raptores), could see better if their retina were blind to the diffused and troublesome violet and blue, while sensitive to some of the invisible infra-red, for which the atmosphere is extremely transparent. We have also shown that, if any living being were sensitive mainly to solar ultra-violet, grass, foliage and flowers would appear to him as dark or black, while a considerable number of yellow flowers would be for him of a bright, luminous color—and white as snow on photographs made in ultra-violet light.

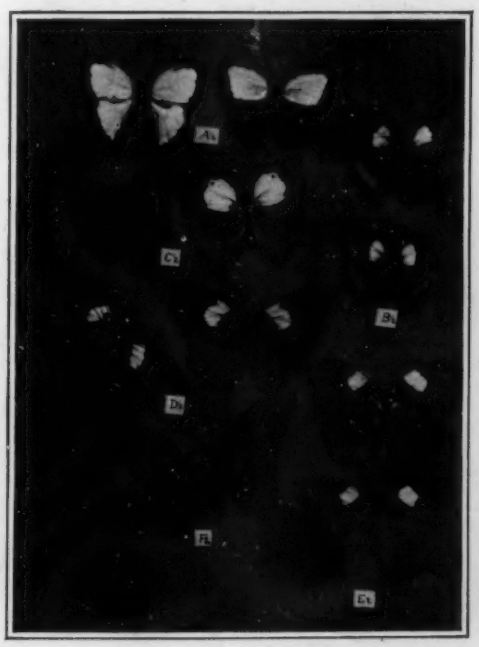
Now, corollas are organs, the main function of which is *to be seen*, in order to attract those insects which play an important part in the fecundation; if no insect can perceive solar ultra-violet light, how is that some flowers are dyed with an intense ultra-violet "color"?

Such is the problem which led us recently to photograph, in ultra-violet and infra-red lights, a number of butterflies, insects the chromatic sense of which is probably highly developed, as, in both breeding and feeding, they are guided mainly by their sense of color. The three accompanying photographs embody the main results of these researches, which can be briefly stated thus:

All pigments on some 65 species of brightly and diversely colored butterflies absorb more or less completely ultra-violet light of the 3,150-3,250 A. U. wave length. The only exception to that rule is a particular kind of yellow pigment which, on the contrary, reflects the short waves so powerfully as to appear snow white on the photographs made in ultra-violet light. Sometimes the eye does perceive a difference between the yellow pigment which reflects the ultra-violet and that which absorbs it. In other cases, such a distinction, at simple sight, is impossible. In many instances one and the same butterfly carries on his wings both kinds of yellow pigment (Callydrias philea., *D.*, in the three illustrations), just as some ultra-violet flowers may appear to be uniformly yellow until a photograph in ultra-violet light reveals the presence of yellow zones which power-

(*Concluded on page* 88)

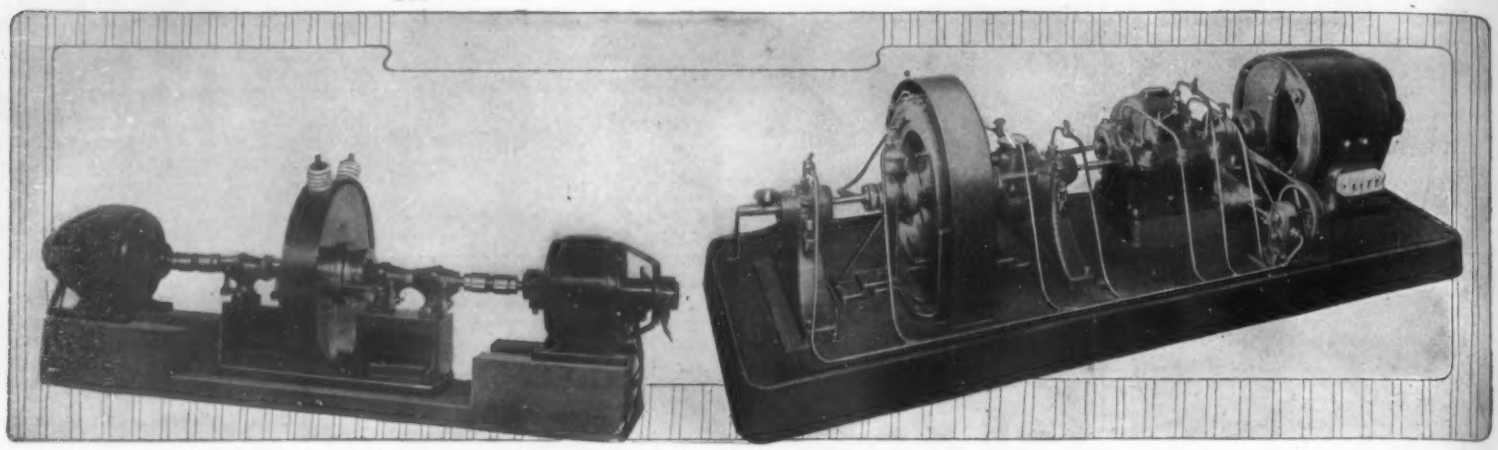
Photograph No. 1. Made on an orthochromatic plate with a weak yellow screen, showing the relative luminosity of colors about as the eye sees it.



Photograph No. 2. Same subject as No. 1. Photograph made in ultra-violet light with Foucault's silver film, deposited on a quartz lens

Photograph No. 3. Same subject as No. 2. This photograph was made in infra-red light with Wood's filter, or sensitized plates

A 1.—Phoebis Argante; *B* 1.—Rhabdodryas trite; *C* 1.—Phoebis rurina; *D* 1.—Callydrias philea; *E* 1.—Anteos chlorinde; *F* 1.—Papilio sp.



Two types of high-frequency alternators for wireless telephony

In the type appearing at the left, the motors at either end drive the inductor disks of the dynamo in the center in opposite directions, so as to give an effective speed twice as high as that of the shafts. At the right appears a modern Fessenden radio frequency alternator which operates at a speed of 2,000 revolutions per minute. It is driven through gears at the center and produces 2,000 watts of alternating current at 100,000 cycles per second.

Progress in Radio Telephony

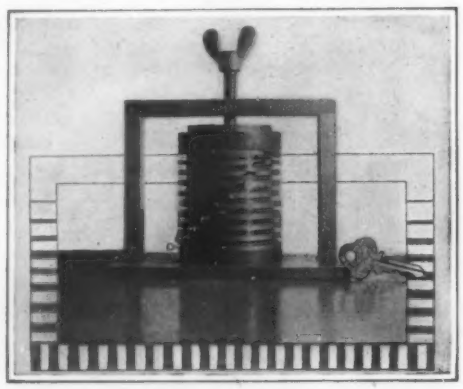
Present Status of the Art the Result of a Decade of Experimenting

By John L. Hogan, Jr.

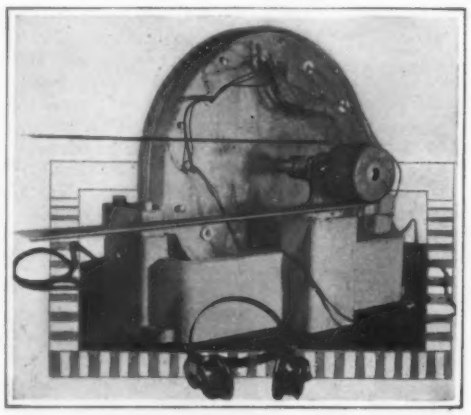
THE conception of radio telephony as a technical possibility dates back almost to the discovery of radio telegraphic receivers which gave indications proportional to the amount of energy arriving from a transmitting station at any instant. When the first of these were put into use and the listening operator found himself able to hear reproduced all the flutters and variations in tone of the spark at the sender, the basis for the "wireless" transmission of speech was at hand. It remained for the inventor first to develop the idea of sending a practically continuous stream of electromagnetic waves from one station to the other, varying them in size or otherwise according to the voice-vibrations of the speaking operator, and, second, to devise instruments for such wave production and modulation.

The first wave-stream generators were of the high group frequency spark type, which set up waves in trains at the rate of 10,000 per second or so. Soon there were built radio frequency alternators which produced current of 10,000, 50,000 and even 100,000 cycles of reversal per second, which, when connected to properly adjusted networks of aerial wires, would cause absolutely continuous streams of waves to be radiated into the "ether." By the use of such generators, with special carbon microphone transmitters or relay-amplifiers for modulating the wave-streams in accordance with the sound waves of articulate speech, R. A. Fessenden found it possible to practice radio telephony as early as 1901. In 1907 the apparatus was so far developed that speech was transmitted from Brant Rock, Mass., over 200 miles to Jamaica, N. Y., and occasionally from Brant Rock some 400 miles to Washington, D. C.

Among the early workers in wireless telephony, after Fessenden, was Valdemar Poulsen, of Denmark, who improved upon the Thompson-Duddell arc for production of high frequency alternating current by causing the electrical discharge to pass in an atmosphere containing hydrogen gas. It is not yet certain that this method of increasing the frequency and stability of the "singing arc" discharge is due to Poulsen alone, but it is none the less a fact that he has used the arrangement for a number of years with excellent results for short and moderate distances. With this apparatus, the circuits of which are shown herewith, continuous current is converted directly into rapidly alternating currents similar to those produced by the high frequency alternator discussed above and suitable for setting up continuous streams of electromagnetic waves when led into an aerial wire circuit. For securing control of their strength by speech, a group of the usual carbon transmitters is connected into the circuit. Thus the system is limited by the restricted power which the microphones can modulate, as well as by the characteristics of the arc itself. Similar arc-and-microphone radio transmitters have been built by a number of other investigators with only minor changes in detail; but these have failed to give entire satisfaction over distances even as short as 10 miles, though Poulsen is believed to have talked over 100 miles.



Small quenched spark gap used to generate waves in polyphase radio telephony. The key serves as a comparison for size



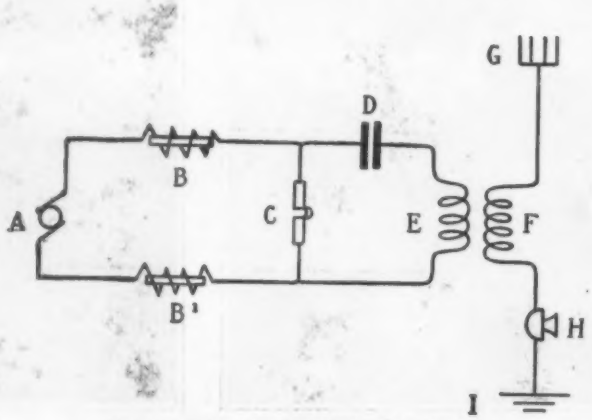
Quarter kilowatt 2,400 cycle 150 volt polyphase alternator for producing high frequency sparks. The machine is about one foot in diameter

In the early days of radio telephony, say up to 1908 or 1909, some interesting work was also done by Count von Arco, of the German "Telefunken" Company. His wave producer consisted of a number of water-cooled arcs in open air (the hydrogen atmosphere being omitted) connected in series, and a carbon microphone designed for large current values. With this instrument speech was transmitted from the Navy station in Brooklyn to that at Fire Island, some 50 miles, and it is stated that the received signals were fairly loud, although the articulation was not good because of the type of microphone supplied.

A few years later the handicaps of using the arc and microphones, which had before been pointed out by some few engineers, became generally appreciated. Since that time efforts in wireless telephony have been mainly toward the elimination of these troublesome elements. Majorana, in Italy, has devised an ingenious form of modulating transmitter in which a moving stream of conducting liquid is used instead of carbon granules as a resistance-changing device. The arrangement is shown below. It is possible that recent forms of this apparatus may prove suitable for commercial service, because good results have been secured experimentally. Up until the last year or two, little other new work of striking importance had been reported.

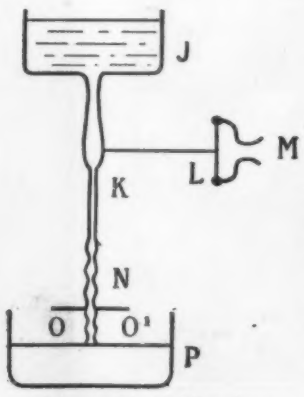
At the present day, however, development of commercial radio telephony is being pushed forward in several quarters and, fittingly enough, the greater part of the work is going on in the United States where wireless telephony originated. About a year ago the Marconi Company telephoned messages from New York to Philadelphia, using what is understood to be the special arc-and-microphone apparatus of a Western investigator, but concerning which no details are obtainable. Also, Dr. D. G. McCaa, of Lancaster, Pa., equipped a coastwise steamer with a telephone of his own construction and succeeded in talking by radio to other ships and to shore stations over distances sometimes as great as 150 miles, when transmission was reported to be "fairly good." Dr. McCaa advises that he is unable to furnish information as to his apparatus at this time, beyond stating that from three to seven amperes were used in the antenna circuit, that a special microphone capable of handling these currents for periods of 20 minutes has been devised, and that the generator of oscillations has no moving parts and is "fool-proof." He also implies that the generator produces sustained trains of waves.

The steamship "Vaterland" is equipped with a new type of wireless telephone built by the Telefunken Company according to the plans lately proposed by Graf von Arco and his assistants. In principle this apparatus is similar to that used with the first 80,000 cycle radio frequency dynamo, though the method of securing the high frequency alternating current is somewhat different. Instead of using a single generator which directly produces current



Poulsen radio telephone transmitter circuits

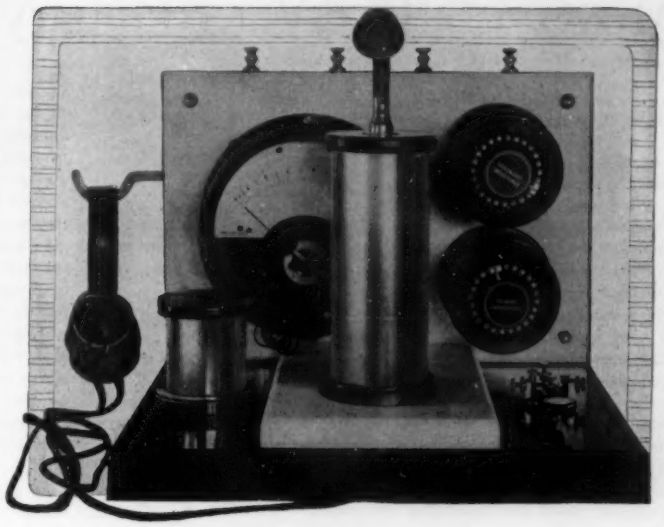
The direct current dynamo *A* supplies the arc *C* through choke-coils *B*, *B*¹. The arc converts the energy into high frequency currents in the condenser *D* and coil *E*, which induces forced oscillations in the secondary coil *F*. This is connected to the aerial wires *G* and, through the microphone transmitter *H*, to the earth at *I*.



Majorana Liquid Microphone

Conducting liquid runs from tank *J* through nozzle *K* to receptacle *P*. *K* is altered by vibrations of diaphragm *L* when spoken against at *M*. Fluctuates in size at *N* and resistance changes between *O*, *O*¹.

of 80,000 cycles or so, the Telefunken telephone includes a dynamo of lower frequency, from which the current is taken to a series of special transformer windings, each arranged to double the frequency of the electrical energy supplied to it. Thus, if the dynamo produces 8,000 cycles, after the first transformation the current will have 16,000 cycles per second. Succeeding steps will give respectively 32,000, 64,000, 128,000 and 256,000 cycles, which last quoted rate would give good radiation from a ship's antenna. This frequency-multiplying method is rather uneconomical, since power is lost at each transformation; but the scheme makes it possible to secure the desirable very high frequencies of current from dynamo machines of quite simple design. In the "Vaterland" telephone, modulation is secured by dividing the current-energy between a large number of microphones, all operating together, each of which controls a part of the generator's output. No information as to distances which were actually transmitted with this outfit is available.



Wireless telephone control panel

Lifting the receivers off the hook starts the sending dynamo. The meter shows the amount of current present in the aerial wires.

Another experimenter in radio telephony at the present time is E. G. Gage, who has built and operated instruments working along the lines both of high group frequencies and of sustained waves. His attention has been for the most part confined to the production of simply operated instruments suitable for use over short distances, in which efficiency is sacrificed to reliability. One of the photographs shows a microphone and control panel which is manipulated much as is the ordinary automatic line telephone. The act of removing the receiver ear pieces from the hook on the left starts the transmitting generator, and in less than half a minute thereafter the apparatus is ready for talking. The two handles at the right permit tuning to various wavelengths for selection of desired stations, and the telegraph key is used for signaling Morse letters to "call" or attract the attention of the station to which it is desired to speak. The modulating transmitter is of a special carbon microphone form designed to carry 1.5 amperes. Oscillators producing wave groups at rates as high as 24,000 per second have been used, but for ordinary work a frequency of 8,000 groups has been found satisfactory. The best results were reached in tests at the Brooklyn Navy Yard, where an alternator such as illustrated herewith was used in connection with frequency-multiplying transformers to produce sustained waves. This method is somewhat analogous to that of von Arco described before, but it is stated that Gage uses different arrangements in the detail of his instruments.

In some of Fessenden's early work it was shown that rapidly recurrent spark discharges, even at a rate below the upper limit of audibility, could be used as oscillation generators for radio telephony. Gage has recently been experimenting along these lines from a station on Long Island Sound; and by using a special polyphase 2,400-cycle generator with a small quenching spark gap, he has succeeded in transmitting speech some 90 miles. The generator illustrated is of ¼ kva output and is used with several quenching gaps sparking in rotation. A special multiple microphone is used in the alternator circuit, so that the power supplied and not the antenna current alone is modulated by the voice. It is found that good speech transmission can be had with spark frequencies of 4,000 per second or even less.

The National Electric Signaling Company, which owns and operates the Fessenden inventions in wireless telephony and telegraphy, has been developing commercial radio telephones at its Brooklyn plant. Modern forms of the original radio frequency dynamo, and of the high spark frequency oscillator are used, with special modulating relays for control of the emitted waves by an ordinary telephone transmitter located either at the radio station or at a distant point connected by wire. Circuits and relays for the interconnection of line and wireless telephones have been evolved, and the work has proceeded in the direction of securing reliability of continuous operation at the highest efficiencies. In the way of actual accomplishments, with the low powered spark telephone (rating less than 100 watts in the antenna circuit, or a little less power than is used to light an ordinary 32-candle-power carbon filament incandescent lamp), easily understood speech has been transmitted from Brooklyn to New London, Conn., something over 100 miles, and to Long Island Sound steamers over 50 miles away. In these tests the receivers were equipped with the usual rugged "crystal" detectors, and no amplifying apparatus was used.

This company has also developed a new radio-frequency alternator for the direct generation of sustained waves having frequencies as high as 150,000 per second, which is used in conjunction with simple telephone transmitters of the usual type for short distances. For distances upward of 100 miles a powerful type of modulating relay has been built. It is used either with the large high frequency alternators or the spark oscillators.

Lloyd Espenschied, who installed the temporary radio-telephone station at Pearl Harbor, Hawaii

Within the past few months the Western Electric Company has announced some startling feats of long distance radio telephony. As was pointed out above, increasing the possible transmission has required the development of modulating apparatus capable of controlling comparatively large amounts of high-frequency electrical power. Distance of communication may also be increased by using very delicate receivers, since less received power is then required to produce a clear indication. By combining these principles, wireless speech has been transmitted from Arlington across the Atlantic ocean to the Eiffel Tower and across the American continent and Pacific ocean to Hawaii. No authorized figures as to the amount of power radiated or controlled are available, but the input to the aerial at Arlington has been stated to be about 20 kw. It is especially interesting that instead of generating the continuous oscillations of this power and then modulating them by rugged and effective modulators, a small high-frequency current is understood to have been produced and modulated by an ordinary microphone. The speech-carrying but feeble current was then passed through a series of amplifiers until the final great power of some 20 kw. was reached.

At the receiving stations very sensitive magnifying apparatus was used, so that far less power was required to cover the great distances than would have been needed to operate the ordinary receivers. This condition, of course, rendered the transmission subject to interruption by atmospheric interference, as stated in the press reports of the tests. By use of the several forms of telephone relays which the Western Electric Company has developed during the last year, it was found possible to interlink the wire and radio telephone systems. Thus between New York and San Francisco two-way conversations could be held, the path being by wire to Arlington, wireless to Mare Island, Cal., and by wire back to New York.

It would seem that wireless telephony is soon to become a commercial reality in at least one of its natural fields, to wit, marine signaling where wires cannot be laid and where it is inexpedient to keep trained telegraph operators on duty. The fact that speech transmission by radio is distortionless, or in other words, that the voice is transmitted by wireless without the loss of articulation which proves so troublesome in line telephony, indicates that the radio will ultimately find use as a trunk connection for linking widely separated line exchange systems. Before this can be realized commercially, however, it is necessary so to develop the generating and particularly the modulating instruments that continuous conversations can be held over 500 or more miles without failure on account of atmospheric or other interferences or through fatigue of apparatus. It appears that this point has not been reached, but since the need exists it is probable that some of the investigators who are attempting to extend the original work will in time reach satisfactory solutions of the several remaining problems.

The Man Who Heard Washington in Hawaii

So wonderful have been the recent successes of the wireless telephone apparatus with which communication was established between Arlington, near Washington, D. C., and Darien, Paris, San Francisco and Honolulu, that the minor yet interesting details have been overlooked. Still, as these little details are becoming known there is aroused a greater appreciation of what has been accomplished by the engineers in charge of the tests, as a result of the increased knowledge of the handicaps which confronted them.

Not the least interesting of the minor details of the wireless telephone tests was the temporary installation of a receiving set at the Pearl Harbor yard, near Honolulu. Lloyd Espenschied, the engineer to whom was assigned the task of receiving the wireless telephone conversation at that point, found the regular aerial at Honolulu unsuitable for his purposes. Undaunted, he set about to overcome this obstacle. He strung a small, makeshift aerial between the smokestack and a water tank at the Pearl Harbor yard—an antenna so small as to make the final results truly remarkable, especially when recalling the fact that his station was the furthest removed from the Arlington transmitter. To be exact, the aerial measured 250 feet in length and was supported between a smokestack and water tank measuring, respectively, 100 feet and 80 feet high. The connection from the end of the aerial to the operating room was from the top of the smokestack to a pole 30 feet high just outside the operating room and approximately 400

(Concluded on page 89)

Forge shop of Pratt Institute, where Lloyd Espenschied utilized the steel smoke stack as a wireless antenna. The forge has since been torn down and replaced by a modern building

Strategic Moves of the War, January 7th, 1916

By Our Military Expert

AT last the expected activity on the Russian front seems to be developing in strength, through a section of Austria-Hungary so far little touched by the ravages of warfare—Bukovina, the most easterly possession of the dual empire.

As yet, it is impossible to definitely discern the great objective of the movement; for developments along the southern part of the line have not yet progressed sufficiently to indicate; but for purposes of analysis it is well to consider two principal factors in the general situation.

For a number of weeks, Russian regeneration of strength has been reported in the meager dispatches which have percolated in some way through the censorship which has held Russ news in its grasp. Much-needed supplies of arms and ammunition, the thousand-and-one accessories needed for the prosecution of a campaign of stupendous proportions, have poured into the czar's domains through the gateway of Archangel and over the Trans-Siberian road, according to report. Fresh levies have gathered to the colors in replacement of the tremendous losses sustained during the late victorious Teutonic drive. Possibly, therefore, the launching of offensive activity is merely the termination of the period of preparation and the inauguration of general attack, made possible by the descent of bitter winter upon stream, morass and mud-ridden road, so that transportation and guns may move.

On the other hand, diplomatic as well as strategic causes may lie at the base of the initiation of the offensive. Serbia, most of Albania and little Montenegro have been cleared of defenders, so that the roadway to Constantinople may be more surely safeguarded by control of a broad span of territory contiguous to it as well as to demonstrate to wavering Balkan states that the promised punishment of Serbia was not forgotten—a veritable and impressive "rattling of the sword."

But the situation becomes more intense. Whether by accident or design, rumors of a proposed mighty Teutonic stroke against England, the financial backbone of the Entente, through her eastern empire, have been freely circulated, with alleged details of probable strength thrown in, gratis. Whether this is merely a sanguine shouting of "Boo" remains to be seen. Such a movement hardly seems to warrant belief in its probable success; but it certainly would succeed, if sufficient forces could be found for the venture, in requiring the shift of Entente forces to meet its threat—a weakening of strength somewhere—possibly at Saloniki, where Teutonia still fears Entente influence which might result in arraying the armies of Greece against her.

Roumania, where it was feared that Teutonic diplomacy might prevail, let slip the opportunity offered her to declare for the Teutons and move against Russia. The shift of some hundreds of thousands of Russian troops to her borders is not believed to be the only reason Roumania refused to take the step. The Russ troops could hardly have been concentrated in time to meet the emergency if it had been a real one. There may, therefore, possibly be some reason for Entente belief that a convincing demonstration of strength may sway this country to aline herself with these powers.

Time will alone decide what actuates the present movement; it may be from either or both causes.

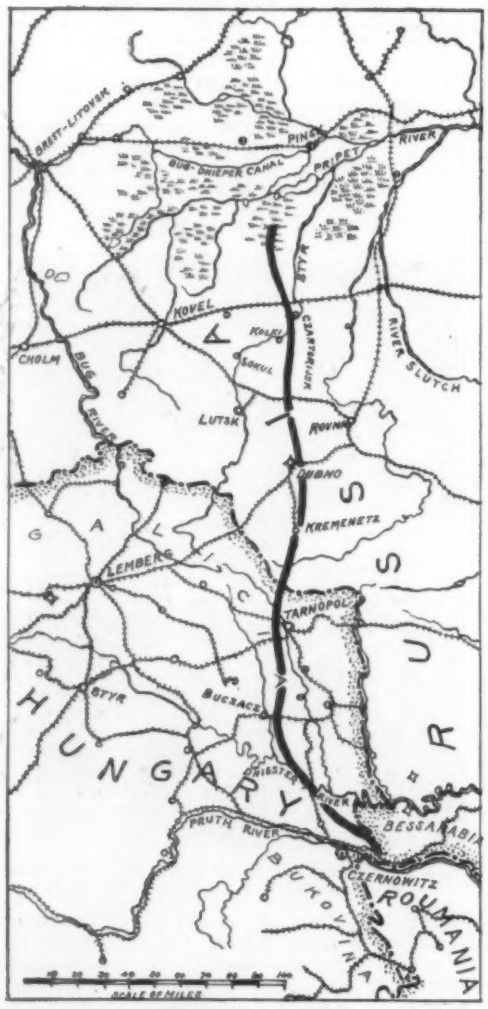
There are two other elements in the general situation which should be considered.

The defenses of Saloniki have been materially strengthened, until, it is reported, that seaport city is practically invulnerable, being closely protected as it is by the great guns of the fleet. Additional troops are reported to be arriving, until the number now present is estimated at something like 200,000—or more. Italy has landed forces in Albania, that country of super-difficult terrain, to assist the remaining yet-defiant Serb and Montenegrin troops who emerged from the great recent drive, sorely battered.

It is, then, not impossible that in the course of time, sufficient Entente strength may be gathered in the Balkans to undertake a forward movement—in combination with a downward thrust from Russia—perhaps with the aid of Roumania or through her territory by her consent; although the latter is hardly probable. Such a combined movement would partake of the nature of the action of great martial shears, designed to cut cleanly communication between the Central Empires and Turkey, would at once vitiate any proposed movement against the British colonies and would require the undivided attention of Teutonia.

If such a severing movement is contemplated, it may be attributed to the recent formation of the so-called Entente general staff. It is no longer a secret that there have previously been dissensions between certain elements of the alliance, in which recrimination as to non-support has been freely bandied. This new advisory board, composed of strategists representing all the Entente powers, has acquired considerable authority and, it is generally believed, will have a material effect upon future operations. This board, which sits in France, must consider the entire situation; its purpose is to so advise operations that from all quarters support may be lent to the achievement of a given objective.

According to reports, some of the kinks have already been straightened out of the Russian line. Below Pripet, along the Styr, the Russ line has bulged forward a trifle to the north of Czartorijsk, and south of the same point, toward Kolki. Material gains have been reported toward Dubno and Kremenetz, while south of Tarnapol (a city of importance which was erroneously indicated as having been in Austrian hands in a recent article of this series) Russ gains toward Buczacz are apparently confirmed.



The southern Russian front

Near the confluence of the Sereth and the Dniester, the Russian line has crossed the latter stream and, pivoting on this point, is swinging steadily upon Czernowitz, and is already reported as commanding the city from heights to the northward.

During the first months of the war, in the course of which the first great Russian forward movement occurred, the Russian line pivoted upon a point near the Roumania-Bokovina border, Dorna Watra, at the foot of the Carpathians, the southern terminus of the railway system which parallels the borders of Roumania. The crest of this tremendous range, at its nearest point, is about 75 miles from the present Russian position and the forbidding wall of the mountains does not offer an easy mode of egress for any Teutonic troops which might be trapped in the Bokovina cul-de-sac should Russ success permit an effective movement upon the railway junction at Delatyn, which covers the railway pass of the same name about 20 miles to the southwest.

As a matter of fact, the southern extremity of the present Russian line is the point in the possession of the Entente nearest to Vienna, and Dorna Watra might well serve as the pivot for future operations, should the pendulum of fate warrant their undertaking.

The activity along the Styr suggests a movement against Kovel, a junction of importance on the main line from Lublin to Kiev. From Kovel, the Rovno railway and the line from the fortress city of Brest Litovsk as well as the short line to Vladimir Volynsk are controlled. Its possession should materially aid the Russian cause, although the strong position at Lutsk, on the Styr, must be taken before any degree of security of communication from menace can be entertained. The far-reaching marshes which lie to the northward of the railway running eastward from Kovel, afford a considerable protection to the right flank of a Russian movement, although the present freezing weather in this section may materially increase the possibilities of movement against these lines.

The magnificent Teutonic organization has previously met each seeming threat; and it is only basing upon past performances to say that in all probability unimpeachable dispositions will be made to meet the present movement. Soon the public should be able to more readily decide the mooted question of Teutonia's waning forces, for should Czernowitz fall, as unconfirmed reports now state it has, and the Bukovina section be opened up to Russ strength, additional Teutonic troops will be necessitated to meet the extension of the line from its present terminus.

How much of the present activity is due to chance and circumstance is hard to say. The passing of the necessity for massing Russian troops on the Roumanian frontier may have offered an opportunity to strike with powerful strength against the nearest part of the Teutonic line. The very shift of forces seems to suggest that an understanding of some sort has been reached with Roumania, although, as a matter of fact, entrance into Roumanian territory may as easily be accomplished across its northwest frontier as across the northeast. A railway penetrates, in this section, from Bukovina into Roumania, striking the Sereth and paralleling its course down the valley. The Russ position may, therefore, be considered as materially improved from any standpoint, if developments prove that the province can be controlled. The river Pruth is no great obstacle, for about 20 miles west-by-north of Czernowitz it bends sharply and trends to the southward, thereby permitting the turning of any Teutonic position behind its lower reach which may be taken, if sufficient forces are operating against it.

The slackening of Teutonic operations in the Balkans seems to indicate that considerable forces have been withdrawn for utilization elsewhere. This may imply that knowledge is in the possession of the Central Empires that a sizable threat is brewing from Russia. If it develops that the heralded general Russian offensive has begun, in all probability there will be considerable activity exhibited from Saloniki and Albania, for it must be the endeavor of the Entente to hold every possible enemy soldier in position, that the line may not be reinforced.

The Queerest Industry—"Breeding" Maggots

OF all things on earth that would seem of no value for any purpose, to most persons nothing can appear more utterly worthless than maggots; the very thought of them is repulsive. And yet they are actually bred for the market in England where they are used as bait for trout and other fish.

There are several so-called "maggot farms" in that country and the wriggly, slimy worms are put up in cans and the better grades command a price of one shilling (24 cents) a quart.

The literature from one particular maggot farm, styled the "Maggotorium," points out that the proprietor, or maggot "farmer," has learned through fifteen years' experience "how to breed maggots of unsurpassable size and quality." Also that "he kills his own cattle and breeds only from beef and liver," enabling him to "guarantee the best maggots in the world"—all of which makes queer reading for American eyes.

Deepening the "New Waterway", Hook of Holland

A BILL, just brought before Parliament (the States General) by the Government, provides for the deepening of the fairway in the "New Waterway," Rotterdam, Hook of Holland, to a depth of 11½ meters, to a width of 100 meters. This improvement, it is estimated, will cost five million florins and will make Rotterdam accessible to the largest ships afloat—also men-of-war—and this latter possibility necessitates another outlay of five and a half million florins for defenses.

Rotterdam, as the greatest beneficiary, has agreed to bear one third of the cost of the improvement of the waterway.

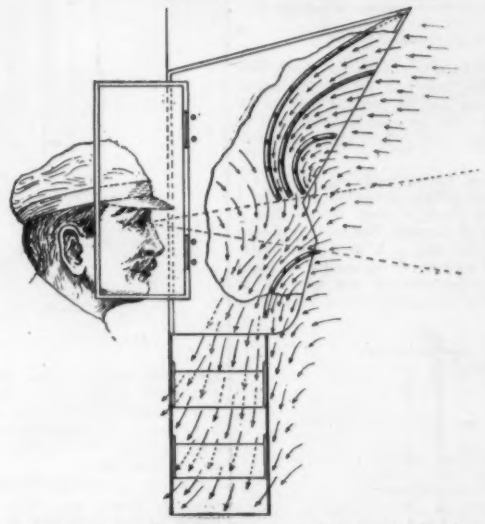
Wind-Deflecting Mask for the Use of Locomotive Engineers

A FEW years ago an engineer on a Canadian railroad was tried for killing several passengers as a result of a rear end collision between his engine and a passenger train ahead. His defense was simply that the weather was 40 degrees below zero, a 40-mile wind was blowing, the severity of which was greatly increased by the speed of his train and it was a human impossibility to withstand the cold long enough to get even a glimpse ahead from the open window. The other windows were so incrusted with ice that they might as well have been solid walls for all that could be seen through them.

The engineer won his own case on the strength of his testimony, but as a result of the case a mask was invented which eliminates the discomforts of looking forward in bitter cold weather and gives the engineer a clear and unobstructed vision, without even glass intervening. The result is secured by deflecting the air currents downward as they enter the mask, and by forming a suction or draft at the bottom all air is drawn away from the engineer's face. So perfect are the results secured that a match held at the back of the shield burns steadily. The space between the deflecting partitions at the top and those at the bottom of the mask is open and it is through this space that the engineer secures a clear view of the track ahead.

The device is being generally adopted by Canadian railroads as a safety measure and for the greater comfort of their engine men.

Locomotive driver using the newly invented mask which assures a clear view ahead irrespective of weather conditions



Sectional view of the engineer's safety mask, showing its effect on air waves

Apparatus for "Breaking In" Tobacco Pipes

WHILE it is true that a pipe smoker works up an affection for a pipe which he has made use of for a long time, it is likewise true that he would discard the old one sooner if it were not for the somewhat objectionable operation of "breaking in" a new one. It requires many days of use before the bowl of a new pipe has acquired a crust on the inner surface, which seems to be essential for the full enjoyment of the smoke. It is now proposed to sell the pipe already "broken"; this task being performed by an electrical carbonizer which has just been patented. It consists of a heating element introduced into the bowl of the pipe and sealed in such a manner that an intense heat is applied to the inside of the bowl, after which it is ready to be placed into the hands of the smoker and put into active service by him at once, without any disagreeable preliminaries.

Labor-Saving Scale-Truck of Compact Design

THERE has recently been introduced a time- and labor-saving device in the form of a combination scale-truck which is so constructed that when the material is placed on the platform on which it is to be transferred, it is weighed without being removed from its position. The scale-truck is simply run under the platform and elevated. The platform of the scale, combined in the elevating truck, then rests against the platform holding the load and accurate weighing is obtained by the usual method; 200 pounds being weighed on the beam of the scale with an allowance of 50 pounds or more for tare. The total weight can be obtained, equal to the full capacity of the scale-truck, by the use of weights placed upon the counterpoise, as in regular weighing scales.

The combination scale-truck is also provided with auxiliary side bars that can be raised and will carry the load in the ordinary manner of the regular elevating truck; the load resting on these side bars, the strain upon the bearing of the scale portion of this device is effectively relieved. It is also possible to raise and elevate the combination scale-truck without interfering with the scale mechanism.

Combination scale-truck in which the scale and the elevating mechanism are independently operated

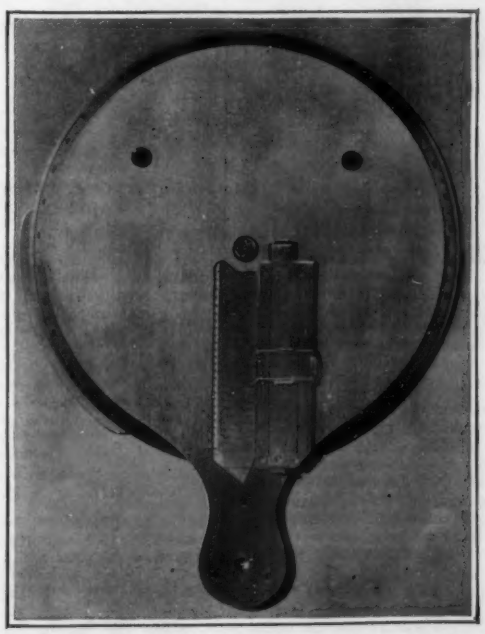
Newly Invented Circular Computer of Marked Accuracy

IN an endeavor to provide a computer of great accuracy for the use of engineers, Louis Ross, a civil engineer of San Francisco, has devised a new instrument that is at once compact, simple, inexpensive and, most important of all, has an accuracy equivalent to that of a slide rule 100 feet long.

The new computer consists essentially of a graduated dial rotating under a slotted cover, a floating guide, and a slide mounted at the right of the slot. The dial carries a scale of numbers reading to five significant figures throughout. The slide carries a miniature of the dial scale reading to three figures. It coöperates with the dial, checks and points out the precise answer and locates its decimal point. For instant or approximate results the slide alone may be used in a manner which is claimed to be more direct and simple than the ordinary slide rule.

The variable graduations of the ordinary slide rule have been dropped completely in the new computer. The system of graduations is absolutely uniform throughout and is as simple as that of a 10-to-the-inch scale. The length of the scale, according to the inventor, is 120 times as great as that of the A and B scales in the ordinary 10-inch slide rule, although the instrument is only 8 inches in diameter. Its operation is comparatively simple and can be mastered with a little practice.

The new computer is made of metal throughout and the graduations engraved on silvered metal surfaces. It is slightly over 8 inches in diameter and weighs less than one pound.



Circular computer with an accuracy said to equal a 100-foot slide rule

French Bureau of Military Inventions

THE French government has organized a special department, under the Minister of Public Instruction, which will be concerned with examining inventions relating to the war. According to the *Journal Officiel*, the object of the Bureau will be to afford a center for the now dispersed inventive talent which it is intended to make valuable by a concentration and effective organization. On this plan, engineering and industrial mobilization will be completed by a scientific coördination. In consequence, the Bureau is charged with examining the propositions of inventors and is to have all the valuable ones worked out to the best advantage, and it also undertakes all scientific researches which may be needed by the War or the Navy Departments. Suitable facilities will be provided for trying out all new apparatus which have a military bearing, and numerous official engineers and officers will follow this work, either at stated times or by a permanent connection with the Bureau of Inventions. This latter is to be controlled by an official commission composed of leading experts. Details of organization of this department will be published at a later date.

The Current Supplement

MUCH interest has been aroused in scientific circles by the remarkable model restorations of *Monster Extinct Reptiles* lately produced by the curator of this department of the National Museum, and the article on the subject, accompanied by a number of striking photographs, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2089, for January 15th, will be widely welcomed. *Possible Sources of Potash in America*, with notes on methods of recovery, is a timely article on a subject of increasing importance. *A New Idea in Electric Locomotives* explains some of the reasons for the type of motors used on the N. & W. road. A train pulled by the new equipment is illustrated. There is a brief description of *A Simple Wireless Telephone Set*, with diagrams. *Radio-Active Substances in the Air, and Atmospheric Fog* is a study of atmospheric conditions of importance to the aviator. *Battle Aeroplanes* discusses the conditions encountered when fighting in the air, and their influence on design and tactics. An important paper deals with *The Periodic Law* and considers the relationship between the atomic weights of different elements, and the places of the rarer gases in Mendelejeff's table. A revised form of this table is given. An article that will be of interest and value to many is a list of the more important *Patents That Expired During the Past Year*. The paper on *The Physiological Importance of Phase Boundaries* is concluded, and there are articles on *Printing Ink and Printing Paper; The Cause and Cure of Pellagra; Grafting Bone and Skin in a French Hospital; Buying and Selling Ore* and notices of *New Books*.

Scarcity of Wire Rope in Russia

IT is reported by the American Consul General at Moscow, Russia, that the petroleum producers of the Baku district are experiencing considerable inconvenience from the scarcity of steel-wire rope. Previous to the war wire rope and wire to be made into rope by Russian manufacturers were imported principally from England. At present, in consequence of the limited exports of steel goods from England, steel-wire rope of British manufacture has almost disappeared from the local markets and its price has arisen from 300 to 400 per cent. At a conference held in Baku to discuss this subject, it was proposed temporarily to substitute for steel-wire ropes, hemp ropes, which it may be possible to obtain from India. It was stated that Swedish wire rope has been found satisfactory for the local requirements of the petroleum industry.

Pulverized-Coal Burners on Steamships

THE combustion of a "spray" of coal dust blown into the fire box by a blast of air is very nearly perfect, eliminating smoke, cinders and firing tools. A very high temperature is obtained, actually melting the ash which runs down the walls of the fire box, and is easily disposed of. The use of this device, so similar to oil burners where a jet of oil is blown in the boiler with a stream of air or steam, is past the experimental stage. However, it has not yet been applied to marine boilers, so shipping interests are watching the experiments planned by the Pacific Coast Steamship Co. This company will charter a tug on Puget Sound and thoroughly test pulverized-coal burners. More heat is obtained from a ton of coal in this way and rather poor coal can be used. It is possible that if the tests succeed coal-dust burners may displace oil burners on many steamships.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

RIDING SKIRT.—P. NARDI, 73 W. 47th St., New York, N. Y. The object of the invention is to provide a new and improved riding skirt arranged to insure a proper fit and perfect safety for riding on ladies' side saddles and

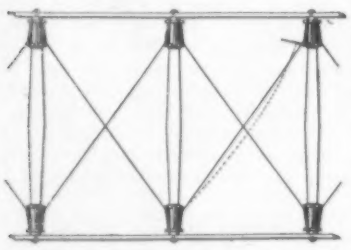
RIDING SKIRT FOR HUNTING.

to prevent the habit from being caught on the pommel or other parts of the saddle in case the rider should fall or be thrown from her mount. This skirt is built especially for hunting in the fields.

HAT FLANGING AND FINISHING MACHINE.—T. J. MACDONALD, 131 Nepperhan Ave., Yonkers, N. Y. This hat flanging and finishing machine is more especially designed for flanging and finishing women's hats, and is arranged to accommodate different shaped hat blocks, to enable the operator to conveniently reach every part of the brim to properly set, flange and finish a hat.

Pertaining to Aviation

AEROPLANE GUY WIRE TIGHTENER.—J. T. HAVENS, 605 Bangs Ave., Asbury Park, N. J. An object of this invention is the provision of a connecting device between the vertical struts and the horizontal beams of the



AEROPLANE GUY WIRE TIGHTENER.

aeroplane structures of an aeroplane, such connecting devices having novel means for fastening the guy wires thereto in such a manner that the wires can be quickly and easily tightened or released.

Electrical Devices

ELEVATOR SIGNAL SYSTEM.—J. G. SOMERS, 267 Nichols Ave., Brooklyn, New York, N. Y. This improvement provides a comparatively simple and efficient signal system which is relatively inexpensive to install and keep in operative condition, thoroughly reliable and efficient in use, and so designed as to be entirely automatic in operation, irrespective of the number of shafts to which the system is applied.

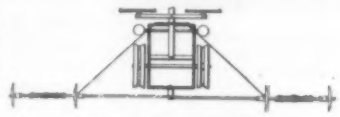
Of Interest to Farmers.

CUTTING MACHINE.—L. E. PARMELEE, Hilliards, Mich. This machine is adapted for cutting standing corn and the like, wherein a wheel support is provided, having cutting mechanism at the front thereof for cutting the standing stalks in the row, and wherein a traveling feed table is provided arranged to carry the material from the cutting mechanism to other mechanism for cutting the stalks in short lengths, suitable for ensilage, and wherein a motor is provided on the support for operating the cutting mechanism and the feed table.

STUMP CUTTING MACHINE.—A. L. MOORE and G. D. MOORE, 213 Hennen Bldg., New Orleans, La. The prime object of the present invention is the provision of improved cutting elements of the machine. The invention is characterized by a centering cutter to enter the stump to center and steady the cutter head as it advances into the stump.

GUARD MEANS FOR THE CUTTING MECHANISM OF BINDERS, MOWERS, &c.—L. M. HAWKINS, R. R. 8, Box 85, Carrollton, Mo. The invention provides a cutting mechanism with a hingedly supported guard plate overhanging the sickle bar and operating to prevent clogging of the bar and adjacent parts with the grass or grain as the same is being cut, said guard plate being so mounted as to be capable of being lifted to allow access to the parts normally covered thereby.

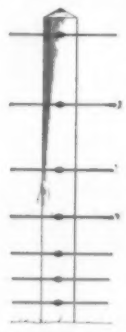
CORN PLANTER MARKER.—G. W. RANDOLPH, Winamac, Ind. This invention relates to corn planters, and one of the main objects thereof is to provide means for marking a plurality of rows suitably spaced apart during the planting operation, ready for guiding the



CORN PLANTER MARKER.

planter on its return trip, back and forth over a field. Another object is to provide means for compensating for inequalities or uneven surface conditions in an automatic manner, in order to mark the rows clearly under all conditions.

FENCE WIRE FASTENER.—C. B. DUDEN, Henryetta, Okla. This invention provides a fence wire seat block of such design that a fence wire can be securely fastened by means of a staple or the like to a fence post without danger of kinking or producing a bight in the wire and maintaining the wire out of contact with the wood, whereby a rusting or



FENCE WIRE FASTENER.

corroding action where contact is made with the fence post when the wires are fastened by the usual method is prevented, and furthermore, the seat block is so designed that the wire can be easily and quickly unfastened by the use of a claw hammer engaging between the seat block and fence post.

POULTRY WING HOLDER.—R. NYCE, R. F. D. No. 1, Lansdale, Pa. This invention provides a device whereby the wings of a fowl may be held back and restrained in such position, so that the fowl may be suitably

POULTRY WING HOLDER.

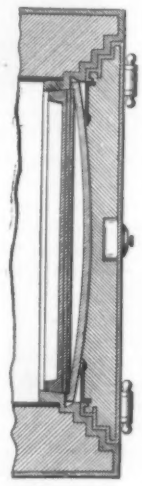
dusted with a germicide. It provides a device of the type described in the nature of a spring clip which may be initially engaged upon the fowl's wings when they are folded back, and a locking device for locking the clip member in position.

Of General Interest

BOTTLE CAP.—L. H. ROSSUCK, Bay Shore, N. Y. The inventor provides facilities for sealing a bottle by means of a metal cap, said cap being provided with means for clamping it firmly and tightly to the neck and providing means for easily removing it from the bottle by hand, the bottle cap being left in condition, after removal, for reapplication to the bottle if desired.

JOINT ANCHOR.—E. C. CORDES, 1250 Edwards Roads, Ohio. An object here is to arch the shank transversely and insert the shank in grooves connecting the openings so that the shank may be flattened in the grooves with the result that the sides of the shank will be embedded in the members at the sides of the grooves. By this means the shank as well as the plates will be secured relatively to the members.

AUXILIARY DOOR FOR SAFES.—H. C. FINK, 713 Colburn St., Toledo, Ohio. The object of this invention is to provide a door element or auxiliary door in connection with the ordinary door or doors of a safe, so arranged as to prevent the safe from being blown



AUXILIARY DOOR FOR SAFES.

open with nitro-glycerine, or other explosives. A further object is to utilize the explosive force exerted against the said door element for releasing a third drill-proof door element and jamming the same into a tapered seat on the door jamb.

TABLE.—G. S. TILLOTSON, care of Sterling Grinding Wheel Co., Tiffin, Ohio. The prime object of the invention is to provide means to tiltably support the table and positively hold it at the desired angle, and to provide for the convenient vertical adjustment of the table, as well as for revolving the table or securing it against turning movement.

CAMERA.—A. F. KELLOGG, Portage, Wis. The present invention is for the purpose of enabling a person to manipulate a movable arm by means of a stylus instead of a pencil and provides means for guiding the operator when no visible means are made on the camera exterior or upon any substance on the camera. Means provide for protecting the arm, for rendering it immovable when not in use, and for maintaining a stylus in convenient position.

LIQUID CIRCULATOR.—W. T. BONNER, 30 Church St., New York, N. Y. The device has for its specific object the lifting of water from a dead or stagnant, and therefore relatively cold zone within a boiler to an elevated zone of higher temperature, whence the water may be conducted by gravity flow to any other point within said boiler and at the same time absorb sufficient heat units to increase its temperature, approximately, to that of the steam within the elevated zone.

PAINT AND VARNISH REMOVER.—H. BIRCHALL, 57 Charles St., New York, N. Y. The object in this case is to provide a composition of matter to be used as a paint and varnish remover which can be cheaply manufactured, is practically odorless and when applied quickly removes paints and varnishes from woodwork, metal structures and other articles and materials.

LITTER AND COLLAPSIBLE FIELD COT.—A. LURIA, 920 Independence Boulevard, Chicago, Ill. An object here is to provide certain connections between the lateral braces of the frame and the legs thereof utilized in the cot formation, whereby the legs will be collapsed to positions adjacent and along the side bars of the frame by the collapsing movement of the lateral braces when the frame is folded.

PROCESS OF PRODUCING SOLUBLE SALTS OF POTASSIUM AND ALUMINUM.—M. F. COOLBAUGH. Address Schrader & Lewis, Rapid City, S. D. In the present patent the invention has reference to improvements in processes for producing soluble salts of potassium and aluminum from silicious and argillaceous earths, rocks or minerals in which compounds of these elements exist in an insoluble form.

PROCESS OF PLATING CAST IRON OR STEEL.—F. MOENCH, Rushville, Ill. An object here is to provide a process of plating cast iron or steel with aluminum so that the latter is firmly secured to the surface of the iron or steel. It provides a process which may be readily carried out without the use of expensive apparatus.

Hardware and Tools

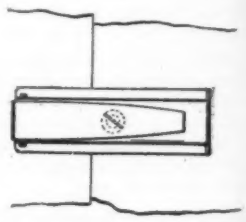
SAFETY TAP AND REAMER WRENCH.—J. DUNNER, 542 Howard Ave., Brooklyn, New York, N. Y. This invention relates to tools and particularly to the handle of tools, as for instance, the handle of tap and reamer wrenches, and the object is to provide means for connecting the handle with the wrench so as to eliminate the chances of breaking the tool in the wrench.

RAKER GAGE.—R. E. GORDON, R. 4, Box 82, Mt. Vernon, Wash. This invention provides a device having a gage clip for use in connection with the sharpening operation and a useful gage for use in connection with the swaging operation, all of which parts are combined in a single device which may be readily manipulated and accurately adjusted and which permits of an unobstructed view at all times of the work being done.

Household Utilities

HEATING STOVE.—S. M. FORD, 1924 Grove Ave., Des Moines, Iowa. Among the objects of the invention is to provide a heating apparatus adapted especially for the use of kerosene as a fuel and comprising a drum within or below which are adapted to be arranged one or more burners to which the oil is fed from a tank supported outside of the drum.

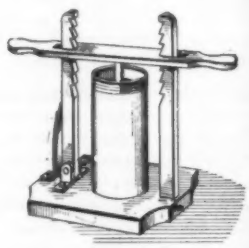
WINDOW BUTTON.—G. V. BRATZEL, Hebron, N. D. The invention relates to a device for fastening a storm window or a window screen in a window frame, and more particularly relates to a device for the indicated purpose in which is included a box-like body adapted



WINDOW BUTTON.

to be pivotally mounted on a window frame to be turned to a position to overlie the window screen or storm window, the body having relatively yielding top and bottom members, there being a cam lever arranged to act on the separable members to cause the same to tightly press against the screen or storm window.

HAM PRESSER AND COOKER.—C. BUTZ, 418 W. 7th St., Muscatine, Iowa. The object here is to provide a device adapted for holding a ham during the cooking thereof, and having means for subjecting the ham to a continuous yielding pressure during the cooking, to force



HAM PRESSER AND COOKER.

the hock end of the ham into the body thereof during the cooking, to lessen the shrinkage of the ham and to save the loss of the hock end of the ham, and wherein the ham is cooked with its natural flavor, requiring no attention during the cooking, and wherein a single utensil will serve for hams of various sizes.

CLOTHES LINE SUPPORT.—L. F. RENAULT and C. J. DRAGO. Address the former, 738a Madison St., Brooklyn, New York, N. Y. The invention relates to clothes line supports and has particular reference to that class of such devices as are intended for use in apartment houses or the like where the clothes to be dried are hung from windows along lines leading to distant posts or other supports.

Machines and Mechanical Devices

SAW FILING MACHINE.—H. I. HANSON, Summit, S. D. The invention provides a machine having means for closely and accurately acquiring adjustments of pitch, depth, and angle, whereby the file may be made to accommodate itself to the variations in the teeth of different saws, and whereby exact and uniform work may be done on the saw teeth.

MEASURING FUNNEL.—R. DE LA ROSA, 2 and 4 Stone St., New York, N. Y. An object here is to provide a valve whereby the funnel may be closed against the passage of liquids therethrough. The invention provides means for actuating said valve from open to closed position after any desired quantity of liquid has been passed through said funnel.

AIR PUMP.—J. A. DREEHOUSE and F. L. DREEHOUSE, Box 177, Laramie, Wyo. The invention relates to air pumps and provides reversing means for the steam pistons of such pumps, the invention being particularly designed for use in connection with conventional pumps, as the Westinghouse or New York pumps, to dispense with the usual reversing rod and with the tappet plate which cause so much trouble at present.

FORMING, CHARGING, AND REMOVING DEVICE FOR BAKER'S OVEN.—A. STREIT, 65 Pitt St., New York, N. Y. This invention provides a device more especially designed to enable a single operator to control the feeding of the matzoth from the forming and cutting machine into carriers mounted on the reel, and

to automatically control the discharge of the baked articles from the carriers.

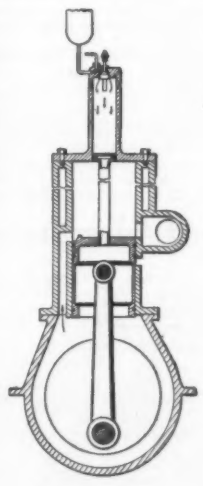
IRONING MACHINE.—E. G. McKAY, Strathclair, Manitoba, Canada. The machine is operated by power and the iron is guided by hand. The purpose of the invention is to facilitate the guiding of the iron and to give the operator greater control over the same; also to provide means for rendering the various parts of the machine readily accessible at all times.

PROPELLING DEVICE FOR TYPEWRITER CARRIAGES.—J. B. BOWEN, Lumberton, N. C. This inventor provides a device by means of which the carriage may be placed under tension so as to move forward in the act of writing, but which may be instantly returned to its original position. He also provides a device in which the return of the carriage to its original position is effected by means of a spring or similar tension device, thereby returning the carriage always with the same velocity or speed.

ANIMAL TRAP.—A. SALOP, 3914 39th Ave., Oakland, Cal. This invention provides a trap having a pair of jaws carrying barbs movable one toward the other by spring action, the means for setting one of the jaws against the tension of the spring adapted to be tripped by contact of the rodent with the setting means, or by contact of earth thrown by the rodent on the setting means, whereby to trip the same and allow impalement of the animal upon closure of the jaws.

Prime Movers and Their Accessories

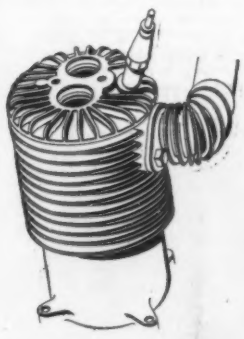
OIL ENGINE.—HARRY T. RASER, Ashtabula, Ohio. This invention provides a means of utilizing for power, oils in various refined or crude state by controlled combustion, in an engine or attachment in which by heat of



OIL ENGINE.

compression of a mixture of oil and air, vaporization and ignition of oil ensues with partial combustion; means being provided whereby the further and complete combustion of said inflamed mixture is carried out in main cylinder. The engraving represents a view in section taken centrally through the cylinders of an engine constructed according to Mr. Raser's invention.

AIR COOLED MOTOR.—F. MOENCH, Rushville, Ill. This invention provides a motor of the internal combustion type which does not necessitate the use of water for cooling the same. It provides a device which is of light



AIR COOLED MOTOR.

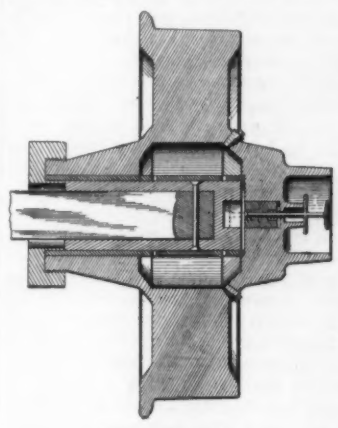
weight, owing to the use of aluminum for the radiating surface. It also provides a motor or engine having means for rapidly radiating the heat developed on the interior of its cylinders owing to the novel construction whereby aluminum forms the greater part of the heat radiating and conducting medium.

Railways and Their Accessories

AUTOMATIC GATE.—W. H. JAY, Laplant, S. D. The invention provides gates for use at railroad crossings, wherein a plurality of similar gates is provided adapted to be arranged on opposite sides of the crossing and each comprising a frame having a passage adapted to register with each other and with the crossing to permit the passage of vehicles and the like, the gates being mounted to roll into and out of the passage and wherein operating mechanism is provided for permitting the gates to be simultaneously closed and opened by a moving train coming from either direction toward the gate.

AUTOMATIC TRAIN STOP.—M. B. BULLA, Hotel Chreptola, El Paso, Tex. This invention provides a construction including the devices carried by the locomotive and comprising an alarm gong, connections with the train air line, and main and auxiliary electric circuits serving first to sound the alarm and subsequently to open the train line when the engineer, through carelessness or incapacity, allows his locomotive to run past a danger point.

MINE CAR WHEEL.—J. COAN, Baldwin, Colo. This invention relates more particularly to an improved mine car or similar type of wheels running loosely on an axle. One of

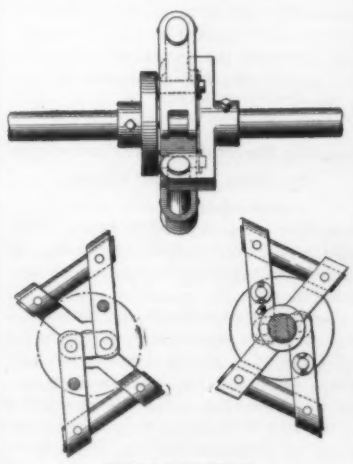


MINE CAR WHEEL.

the principal objects is to provide an improved means especially adaptable to mine car wheels having a fixed axle for locking the wheels with the axle at will to prevent accidental movement of the car along a track.

Pertaining to Vehicles

FLEXIBLE COUPLING.—A. N. CLASSON, Sheridan, Ill. The coupling is constructed with an arm secured to one of the shafts which is rotated by members with which it is engaged at its ends, the members being secured to the outer ends of the levers fulcrumed to a disk secured to the driving shaft and with the inner ends of the levers connected



FLEXIBLE COUPLING.

by a link. The coupling has been in use for a year and employed to operate a direct connected dynamo running at 2,800 R. P. M., and the two shafts do not have to lie parallel or meet centrally. It will be found advantageous for use for automobile magnetos and dynamos, between engine and transmission, and in direct connected farm lighting plants.

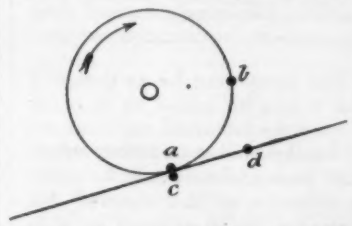
AUTOMOBILE SIGNAL.—J. NICHOLSON. Address Purcell Rowe, Attorney, Monadnock Bldg., San Francisco, Cal. This signal is to be operated by the chauffeur at will to indicate the intention to turn to one side or the other, and to indicate the direction in which it is intended to turn, wherein a plurality of signals is provided for each mud guard, capable of being moved into and out of operative position, and electrically controlled to be moved into operative position and to be held in such position, and wherein spring operated mechanism is provided for automatically releasing the signal after the lapse of a predetermined length of time.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14006) W. H. asks: A locomotive with steam turned on fully, is tugging at a heavy train on a steep grade. The tractile force of the locomotive is exactly balanced by the various opposing forces, the net result being that the train is stalled—that is, poised in stationary position—and so maintained by tension of steam in the cylinders. A rain comes up (or down), and wets the rails, whereupon the locomotive driving-wheels begin to slip and to spin rapidly, so that the train retrogrades a negligible distance. The engineer directs a stream of dry sand upon the rails. He manipulates the flow of sand so skillfully that he renders the friction nearly,



but not quite, normal between the driving wheels and the rails. That is, by means of the sand he reduces the speed of the wheels nearly to zero, so that a given stretch a, b, of the wheel circumference, makes a sliding-rotary contact with a given stretch c, d, of the track rail, the distance c, d, being a little shorter than the distance a, b, say in the ratio of 3 to 2. In other words, the wheels tend to make a few superfluous revolutions for a given length of track. What is the effect upon the train? A. In the query which you send us, accompanied by a sketch of the position of a locomotive driving-wheel, we note that you fixed the center of the wheel at a right angle to the point "c" of the rail, when the point "a" of the wheel is in contact with the point "c" of the rail. Later when the point "b" of the wheel is in contact with the point "d" of the rail the center of the wheel is at a right angle with the point "d" of the rail. The center of the wheel has therefore advanced a distance c-d along the rail. The entire train must have been affected by this advance of the locomotive on the rail.

(14007) T. F. D. asks: I desire a little information to settle an argument. Did the Twentieth Century begin 1900 or 1901? Our postmaster and several prominent business men were mixed up in this, and they were about equally divided. One side took for example the birth of a child; the child is one year old just as soon as you write one year. It has already lived its entire first year. A. The year 1900 was the last year of the nineteenth century, and the twentieth century began on January 1st, 1901, immediately after the instant of midnight. The matter is very simple. Suppose you were counting out buttons in parcels of 100. You count 1, 2, 3, etc. The 100th button belongs to the first parcel. If it were put into the second parcel there would be but 99 buttons in the first, so also the 200th button ends the second parcel, and the 1900th button is the last button of the nineteenth parcel. With years the case is in no wise different. The closing year of a century gives the name to the century. The year 1900 was the last year of the nineteenth century. The same is true of a child. A boy is not ten years old till he has reached the tenth birthday after the day on which he was born. His twentieth year belongs to the second decade of his life. This was fully discussed in the SCIENTIFIC AMERICAN in 1900 and 1901, and none who were our readers at that time need be in doubt on the matter.

(14008) R. B. S. asks: Is it true that sunlight affects the transmission of wireless signals? A. It is common knowledge that wireless stations do not work to the best advantage in bright sunlight. The greatest distances are covered at night or even on cloudy days. While several theories have been offered from time to time in the way of explaining the cause of the decreased efficiency of wireless waves in sunlight, it is generally held that a convincing explanation is still forthcoming.

(14009) W. S. G. asks: Would you kindly inform me what Newton's Laws of Motion are under Notes and Queries? A. Newton's Laws of Motion are the basis of all the discussions of motion in physics. Every text book of physics contains them. The laws are sometimes stated as follows: 1. A body continues in a state of rest or of uniform motion in a straight line, unless compelled to change by some external force. 2. A given force produces the same effect whether it acts upon a body at rest or in motion; whether it acts alone or together with other forces. 3. Action and reaction are equal and opposite in direction.

(14010) D. S. C. asks: In your issue of October 2d you explain to correspondent W. B. that the earth carries with it its atmosphere and thus causes a balloon to descend in the vicinity from which it arose. This raises another question to which I invite your attention: Scientists tell us that outer space is filled with an element to which they have given the name "ether." Since in our orbit around the sun of about 580 million miles we are moving at the rate of approximately 70,000 miles an hour is it not evident that, no matter how tenuous this alleged ether might be, our progress against it at such tremendous velocity would not only sweep away our atmosphere but everything else movable on earth—nay, would not a 70,000-mile speed blow the very globe itself into dust, utterly annihilating it? Moreover, must not this imagined "ether" offer some resistance to the passage of the earth, and would not such resistance—no matter how slight it might be annually—have long ago caused the earth to cease its revolution around the sun? And yet we find that in making this vast journey there is not now and presumably never has been the variation of so much as one second. From these facts I reach the conclusion that the "ether theory" has no basis and that inter-planetary space is absolutely vacant, despite the commonly accepted opinion that "nature abhors a vacuum." A. We note your reasoning regarding the resistance the earth must receive from the ether of space, but are, we regret to say, not able to accept your conclusions. The fact is that the earth shows no retardation in its orbit. The conclusion is that the ether is vastly more tenuous than any other *substance* of which we have any knowledge. This, contrasted with the immense weight and enormous velocity of the earth, makes the resistance an infinitesimal quantity and the earth shows no decrease in its orbital velocity. Even the enormous resistance of the tides to its motion of rotation has not lengthened the day within historic time. The "ether theory" is firmly fixed in science, and the objections which you urge against it have been fully considered by scientific men.

(14011) C. L. H. asks: I am desirous of finding out if the different hardnesses of copper remain of the same hardness after they are put through an electroplating process and deposited on other metal. A. We see no reason why copper deposited by electroplating should not be all of the same hardness, no matter how hard or soft the plate from which the copper is deposited. The molecules pass through the liquid form, or the ionic form, and will all be alike in constitution when they are deposited from the solution. Copper is hardened by physical means and when heated again resumes its soft condition.

(14012) R. T. L. asks: I would now like to get some of the common names of the different chemical substances. For instance: *chemical name*, Potassium bitartrate; *common name*, cream of tartar. Have you any book giving the common and chemical names? If so, please give price and title. A. We recommend and can supply you with Newell's Descriptive Chemistry for $1.30, postpaid, which contains many of the common names of chemicals, such as muriatic acid, blue stone, aqua fortis, oil of vitriol and many others. A great many chemicals have no common names and you must use the real name or have no name at all. The large dictionaries probably contain all the common names of chemicals. The elementary text books of chemistry are more likely to give common names than the higher class of books. It is not desirable to have two or sometimes more names for the same thing.

(14013) S. P. asks: As a reader of your paper and one who is very much interested in scientific knowledge, I desire to appeal for the help of your worthy journal to kindly give me any information, within your power, on the following question: How did the original nebulae of gas, supposedly the sun, receive its rotary motion? I have already hunted for an explanation to this question in many different directions and from men of high scientific authority, but all of them seem to know no more than I. I have even spent hours consulting the famous "Laplacean Nebulae Hypothesis," only to find this answer: "The nebulae *was endowed* with a slow rotary motion." A. If you will reflect a little we feel sure that you will realize that no one can know how the original nebula obtained its rotary motion. Who was there to bring the story? The fact that all the planets move in the same direction and all of the moons which were known in the time of La Place, that the sun and all the planets turn on their axes in the same direction, was a sufficient reason for saying that the original nebula rotated in the same direction at the time it began to throw off the planets. There is no one who can give a reason why. You will have to be content with the fact as it is. Science has its mysteries as deep as those of theology.

Anticipating Telephone Needs

When a new subscriber is handed his telephone, there is given over to his use a share in the pole lines, underground conduits and cables, switchboards, exchange buildings, and in every other part of the complex mechanism of the telephone plant.

It is obvious that this equipment could not be installed for each new connection. It would mean constantly rebuilding the plant, with enormous expense and delay. Therefore, practically everything but the telephone instrument must be in place at the time service is demanded.

Consider what this involves. The telephone company must forecast the needs of the public. It must calculate increases in population in city and country. It must figure the growth of business districts. It must estimate the number of possible telephone users and their approximate location everywhere.

The plant must be so designed that it may be added to in order to meet the estimated requirements of five, ten and even twenty years. And these additions must be ready in advance of the demand for them—as far in advance as it is economical to make them.

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A Sixty-Cycle Million-Volt Transformer

(*Concluded from page 77*)

that very peculiar sensations are experienced by persons who may be standing therein.

When the net is charged and the gap is open so that no discharge takes place to ground, the results are quite remarkable. The net and all connecting wires show luminous with corona, while intense brush discharge occurs at all corners and at dead ends. The wires hum and the building vibrates to the tune of 60 cycles. The iron bolts become highly charged and if one is grasped by the bare hand a sensation is produced which is similar to that experienced when handling low tension current at the same frequency.

The electric field is most dense directly beneath the net, and it is here that the results are most spectacular. If the hand is held in the air above the head a brush discharge takes place from the tips of the fingers. If a hat is held in the hand sparks can be drawn from the band of the hat. Metallic objects such as umbrellas and hair pins become exceedingly obnoxious to their bearers. Sparks can be drawn between various people, the length depending upon the relative difference of potential of each person with respect to the ground. A metallic object thrown into the air is charged and becomes luminous. Incandescent lamp bulbs held in the hand glow with the pale blue light characteristic of a discharge through a medium of rarified air. Sparks several inches long can be drawn from metallic plates supported in the air a few feet above the ground. This discharge can be taken into the body, but the sensation is rather unpleasant. The current is sufficient to kindle paper if the latter is pierced by the spark for a considerable time. The odor of ozone permeates the atmosphere in the vicinity of the apparatus.

Similar results, on a much smaller scale, have been attained with currents of less magnitude, but these are claimed to be the first experiments conducted with such low frequency high tension current. They have proven the practicability of the Thordarson type of transformer construction and have paved the way for further investigation of the transmission of power over great distances at unusually high tension.

Probable Perception of Invisible Light by Some Animal Species

(*Concluded from page* 81)

fully absorb the rays while other yellow zones powerfully reflect them—for example, common squash flower and dandelion flower.

That in both butterflies and flowers the only pigment which reflects the ultra-violet should be yellow seems to be something more than a mere coincidence, but we utterly fail to see the significance of the fact if it has any. On the other hand, it seems to us that there is no good reason why the presence of an intense ultra-violet color on the wings of many butterflies should receive an interpretation different from that so far given to the presence of other colors visible to us; its *raison d'être* may be to favor the union of sexes or to protect those butterflies which feed on ultra-violet flowers. If it be borne in mind that the enormous compound eyes of butterflies fill most of the head, while a pair of supplementary simple eyes, the use of which is not known, generally occupies the top of the head, it seems no wonder that such a complicated visual apparatus should be, in some respects, more complete than ours and perhaps sensitive to wave lengths somewhat shorter than the short wave extreme of our visible spectrum.

The sensitiveness of butterflies' eyes to the other extreme of the spectrum, *i. e.*, to the extreme red and beginning of the infra-red, seems much less probable. We have shown that, in the extreme red region of the spectrum, all flowers are white; that is to say, they uniformly and powerfully reflect light of a wave length greater than that corresponding to the red. Far from being useful to butterflies, the main result of a keen perception of

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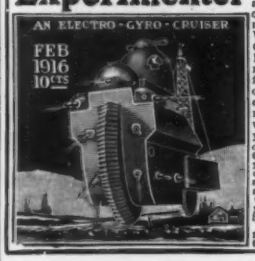

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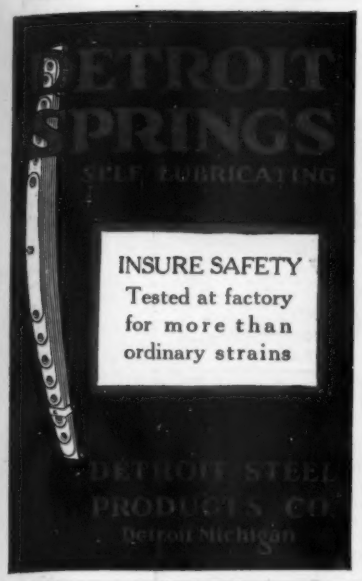

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great wave lengths would be a considerable damping of the chromatic differences which allow each species to select, among flowers, those best adapted to their digestive organs.

The first photograph was made on an orthochromatic plate, with a weak yellow screen. It accordingly shows the butterflies about as they appear to the eye, that is, with each color keeping its relative luminosity. The third photograph, on the other hand, was made in direct solar light, with Wood's filter, on plates sensitized with alizarine blue and silver nitrates. The second photograph was made in diffused sky light with Foucault's silver film deposited on a quartz lens.

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The Man Who Heard Washington in Hawaii

(*Concluded from page* 83)

feet distant from the stack, at right angles to the span. Crude as obviously was this antenna, Mr. Espenschied intercepted the radio telephone waves and heard the conversation between Arlington and San Francisco. In all, a distance of 4,900 miles was covered between the transmitting aerial at Arlington and his temporary station.

That Mr. Espenchied's experience in installing a wireless telegraph set at Pratt Institute while a student served him to good stead is disclosed in the reminiscences of Samuel S. Edmands, Director of the School of Science and Technology of that institute. The story is best told by Mr. Edmands:

"During the early months of 1909, Mr. Lloyd Espenschied, who was then a student at Pratt Institute in the course in applied electricity, was engaged along with a number of other students and instructors in the making and installing of a wireless telegraphy outfit in the electrical laboratory.

"Apparatus for the Institute's wireless station was in process of design and construction by the students and there arose occasion for testing certain parts of the receiving apparatus. At that time the aerial antennæ had not been erected, and it was necessary to find something which might serve as a substitute for the proposed test. Mr. Espenschied decided to try to utilize a steel smoke stack, which rose above the roofs of the buildings, and was a part of the smoke exhaust system of the school's forge shop.

"Mr. Espenschied arranged his apparatus on the dead coals of one of the forges not in use, and connected his aerial conductor to the steel hood over the forge. No sooner had he applied the receivers to his ears and tuned the apparatus than he heard a wireless station in Philadelphia calling a station on the roof of the Plaza Hotel in New York city. There followed a message addressed to Prof. M. I. Pupin, of Columbia University, famed for his inventions in the field of electrical communication, both with and without wires. This message Mr. Espenschied wrote down and handed to one of his instructors, Prof. J. H. Morecroft, who happened to pass at the moment on his way to Columbia University to attend a lecture by Prof. Pupin. This copy of the message reached Prof. Pupin before the arrival of the same message via the Hotel Plaza station, and Prof. Pupin was greatly entertained by the account of how the message had been caught through the unconventional medium of a forge shop, and had through a rather remarkable circumstance reached him before its arrival through the regular channels.

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Industrial Preparedness for Peace

(*Concluded from page* 78)

problem of efficiency. We know a great deal about the chemistry of material things, but our knowledge of *human* chemicals is exceedingly limited. In mobilizing our forces for industrial preparedness for peace we want no premature explosions, we want no sudden precipitation in our melting-pot. It would seem that the first principle of scientific management would be *coöperation*. Coöperation through *consent* and not *conscription*. It is a human problem. Largely common-sense! The time has passed when we can impose upon men systems and devices, schemes and programs, without their understanding and consent. We need, and we shall demand, coöperation in the mobilization for industrial preparedness. We must insist, however, that that coöperation is attained through consent, and not by pressure. We are mobilizing for prosperity, not mutinousness. We can afford to set aside our ultimate ideals for the moment, forget our immediate differences, and take stock.

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3. What is our defense?
4. What forces have we for immediate mobilization?
5. What forces have we in reserve?
6. What strategic points do we hold?
7. What strategic points are held by the invader?
8. What are our plans for defensive operations?

OFFENSIVE.

1. What will be the opportunities for industrial expansion?
2. What markets will be open throughout the world?
3. What opposition will we meet?
4. How shall we meet it?
5. What support will we receive at home?

The Solution

There will be great diversity of opinion upon each and every point under discussion. We hope to get men thinking about the problem and start analyzing their own position in relation to it as a whole. We want men to take stock of their own opinions, to sum up their own experience and tie it in with industrial and economic history.

Industrial Preparedness for Peace means efficiency of the highest order. We are not to become slaves to the machinery of industry, but masters of the mechanism of the nation's business. Our national efficiency shall not be measured in the terms of mere productive capacity, but in the sum total of human happiness we can get out of our opportunities. We are not preparing to die for posterity; we are preparing to live for posterity. Industrial preparedness means preparedness to sustain the shocks of necessity. The problem is economic, but not all economic. We desire to live peacefully, but not slothfully; we desire to trade with the world, but not through a hole in a Chinese wall. We do not wish to live in the shadow; we demand a place in the sun, achieved not by military but by industrial effort.

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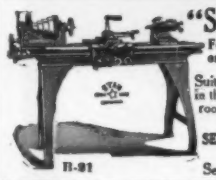

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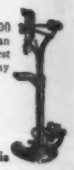

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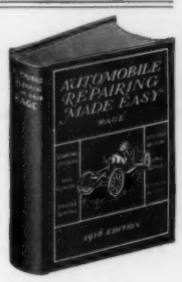

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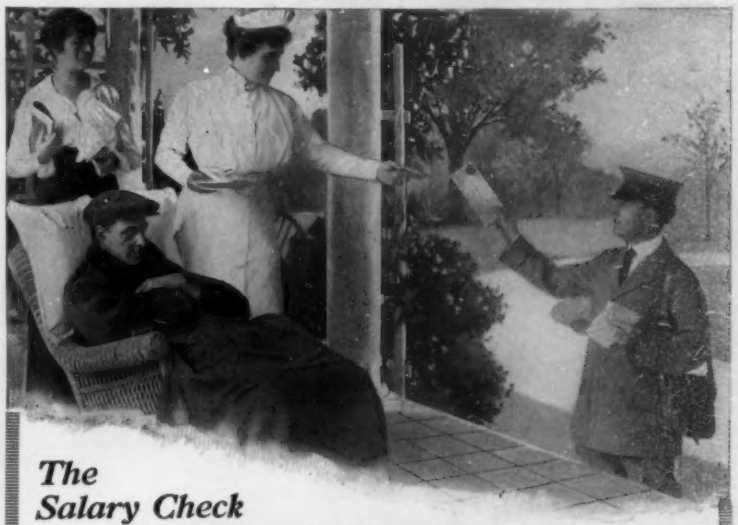

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